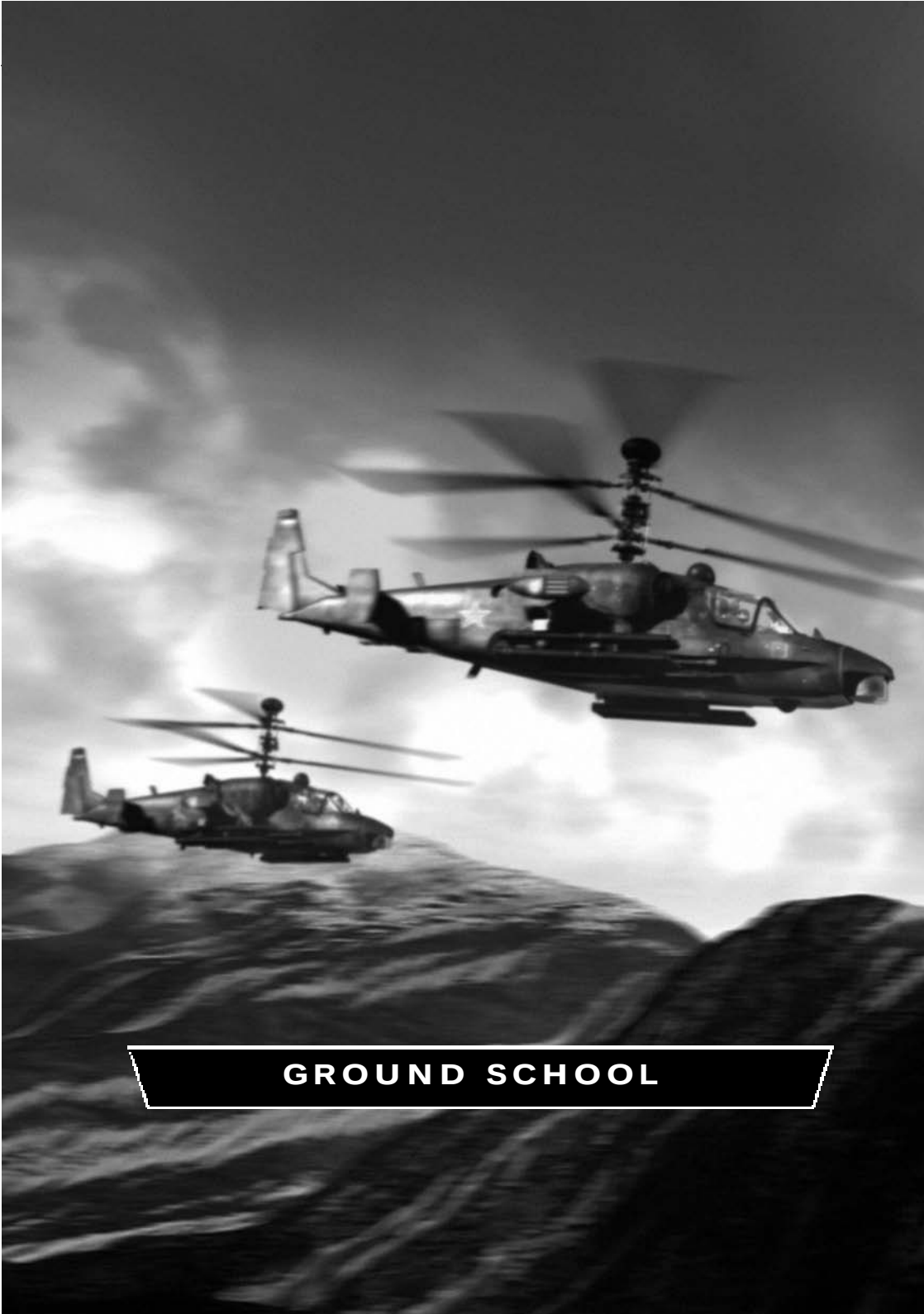

GROUND SCHOOL

Helicopters - Basic Principles and Handling

This chapter is intended as a strictly practical guide for those who know little or nothing about how to fly a helicopter. It concentrates on what you need to know as a pilot and contains very little aerodynamic theory. Helicopters are untidy pragmatical machines which defy any attempt at elegant theoretical analysis, but the basic principles are simple enough. Once you understand what the controls do, and where the pitfalls are, flying a helicopter is (like any other job requiring more than one hand) mainly a matter of coordination and practice. In this writer's experience, it seems to be easier than learning to juggle - you have a lot more time to think about what happens next.

Conventional Helicopter Layout - Main and Tail Rotors

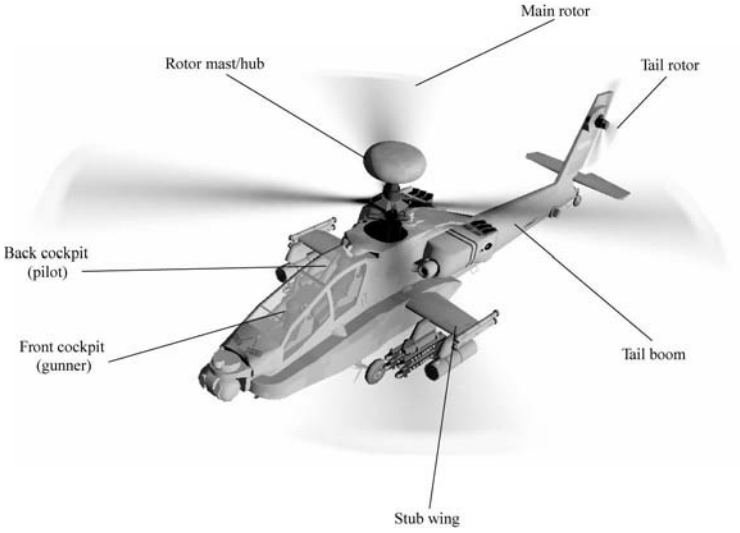


Diagram 6.1: Conventional attack helicopter layout

The general layout of a conventional helicopter has a large main rotor and a much smaller tail rotor, driven by powerful turboshaft engines. The main rotor, as you probably know, provides the thrust which lifts the helicopter and moves it forward (or backward, or sideways). The tail rotor's purpose is less obvious.

Imagine yourself sitting in a swivel chair, with your feet tucked up so the chair can spin freely. Your arms are above your head, supporting the middle of a long heavy plank. The plank is the helicopter's main rotor and you are the engine. The swivel chair is the rest of the helicopter, off the ground and free to pivot. Now start spinning the plank round and round like a rotor. As you do this, you'll find yourself spinning around in the opposite direction to the rotor. The harder you spin the rotor, the faster you spin yourself - and in this example, there's nothing you can do to stop yourself spinning except put your feet on the ground, which equates to landing the helicopter. This tendency for the engine to spin the whole helicopter in the opposite direction to the main rotor can be called Main Rotor Torque Effect.

The tail rotor solves this problem by creating a thrust in the opposite direction to the main rotor torque effect. Its small size is compensated by the fact that it's mounted at the end of a long lever (the tail-boom) which magnifies its effect. Also, by changing the amount of thrust the tail rotor produces you can pivot the whole helicopter on the spot, in either direction.

How Rotors Work

A rotor is simply a set of long thin wings attached to a central hub. The wings are more commonly called Rotor Blades, and when the rotor is spinning, the whole assembly is often referred to as the Rotor Disc. Just as in an ordinary aircraft, the wings generate a lift force when they are moved through the air. How much lift a wing generates is governed by three factors:

1: The Density of the Air

The atmosphere is densest (and provides most lift) at sea level. As you climb above sea level the density decreases and the wing produces less lift. Air temperature also affects density – hot air is less dense than cold air, and gives less lift. 'Hot and high' is the worst combination of conditions, and in practical terms this means you can lift less weight and have less 'performance' available.

2: The Wing's Speed Through the Air

The faster a wing moves through the air, the more lift it generates. In sophisticated modern helicopters the rotors spin up to a set flying speed before take-off and hardly change speed in flight, unless you demand more power than the engines can provide or something goes wrong with the engines or the transmission system. You don't control lift by changing the rotor speed, so at first sight this factor seems irrelevant – and it is indeed irrelevant in hovering or vertical flight. However, when the helicopter is moving forward at high speed this factor becomes critically important, and determines the maximum safe flying speed – and what happens when you exceed it [see page 6.19 – Retreating Blade Stall].

3: The Angle at Which the Wing Meets the Airflow

This is generally known as the Angle of Attack and up to a point which varies with the wing design, the greater the angle of attack the more lift the wing generates (and the more power is required to drive it through the air at a given speed). All of the helicopter's main flying controls work by changing the pitch angle of the main or tail rotor blades.

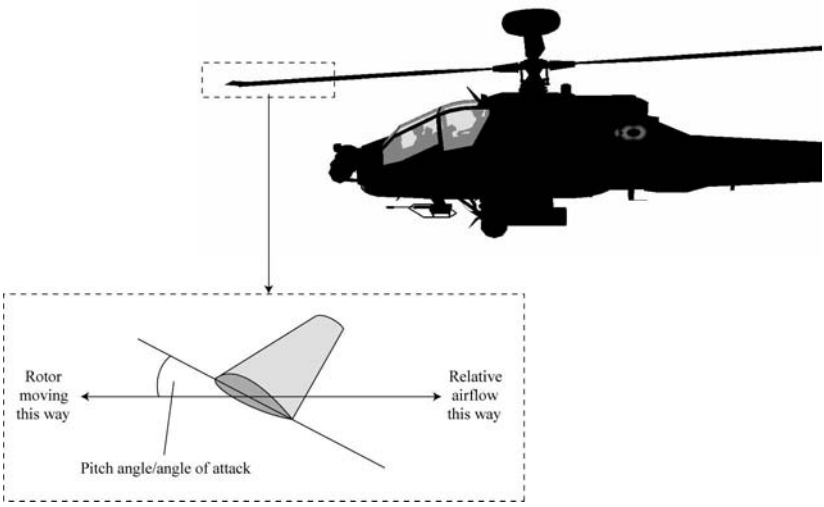


Diagram 6.2: Rotor pitch angle/angle of attack in still air

If the rotor were operating in still air, pitch angle and angle of attack would be identical, but this situation exists only in the first few seconds as the rotor spins up [diagram 6.2]. Once the rotor is spinning it sets up a constant air current (the rotor downwash) through the rotor disc. This means that the effective angle of attack is less than the blade pitch angle – though not much less because the rotor's speed is generally much higher than the speed of the air current down through the disc [diagram 6.3].

If there is an air current across the disc (as there is when you are hovering in a wind or moving over the ground at any significant speed) this also changes the effective angle of attack (and airspeed) of the rotor blades [diagram 6.4]. Blades advancing into the wind have a higher angle of attack (and higher airspeed), and generate more lift than the retreating blades. At the same time, the effect of the downwash air current is reduced because you are constantly moving into undisturbed air.

The net result is that the rotor generates more lift altogether ('Translational Lift'), and more lift on the advancing than on the retreating side of the disc, so there is a slight tendency to roll (a 'rolling moment') around the wind axis – an imaginary line through the center of the helicopter drawn in the direction of the airflow [diagram 6.5].

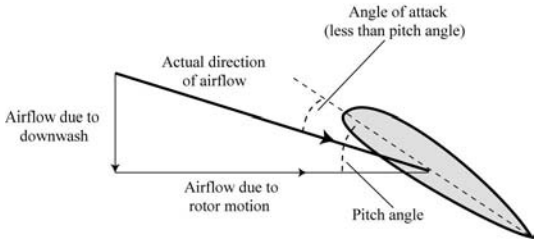


Diagram 6.3: Pitch angle/angle of attack with rotor downwash

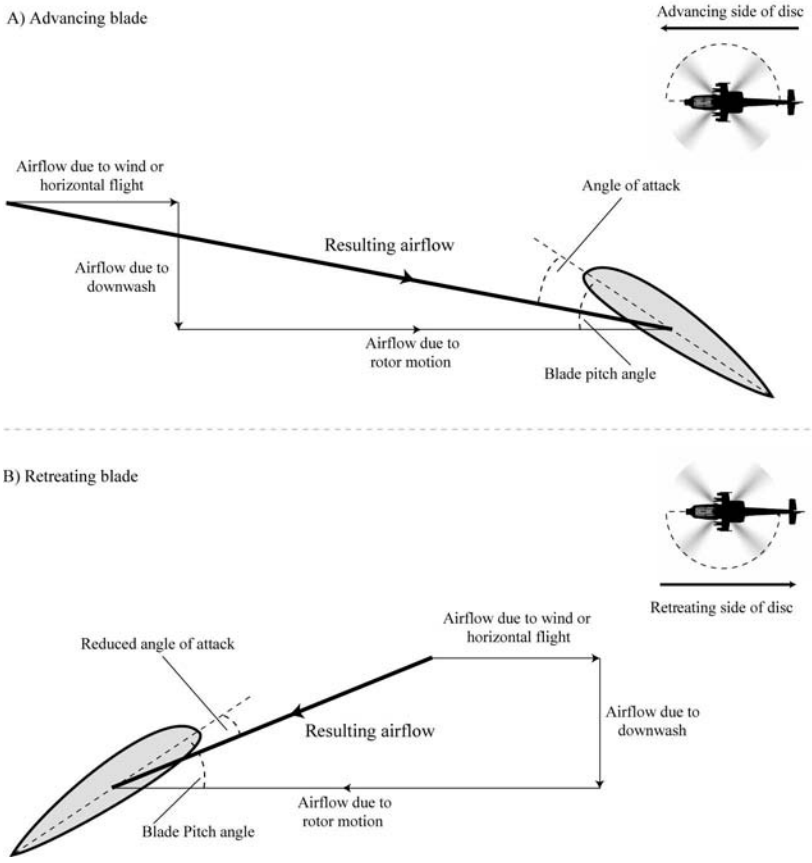


Diagram 6.4: Pitch angle/angle of attack with airflow across rotor disc

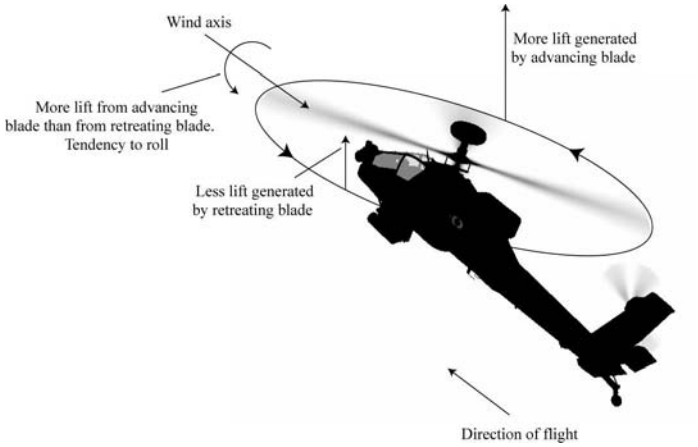


Diagram 6.5: Rolling moment with airflow across rotor disc

Flying Controls of a Helicopter

Three controls are used to fly a helicopter; the collective lever, the cyclic stick, and the yaw pedals [diagram 6.6]. Each has a Primary (main) and a Secondary (side) effect.

Collective Lever:

This is mounted on the left side of the seat, and pivots up and down about its back end, like the handbrake on most European cars. It is used with the left hand, and has a friction clamp so that when you take your hand off, it stays in the position where you left it. The three phrases commonly used to describe what you can do with it are 'raising the collective', 'lowering the collective', and 'bottoming the collective'. All three are simple, literal descriptions.

When you raise the collective, you are increasing the angle of attack of all the main rotor blades by the same amount, so that the rotor generates more thrust. Lowering the collective has the opposite effect. Bottoming the collective reduces main rotor thrust to effectively nothing. If you were hovering, raising the collective would cause the helicopter to climb straight up, lowering the collective would cause the helicopter to descend. This is the primary effect of the collective control.

The secondary effect of the collective is due to the fact that it takes more power to drive the rotor through the air at a high angle of attack than at a low one. In older (or simpler) helicopters, the pilot has to use a twist-grip on the collective lever to add or reduce power. More sophisticated modern helicopters do this automatically. In either case, because the engine must develop more or less power, the main rotor torque effect becomes larger or

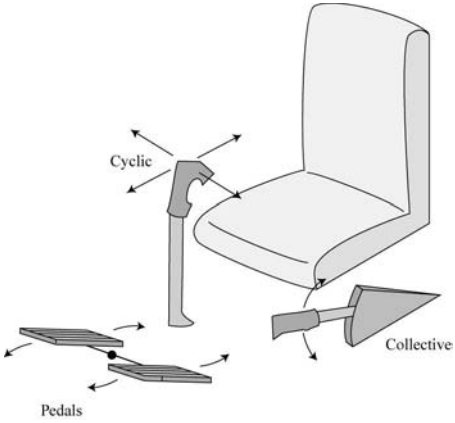


Diagram 6.6: Main flying controls

smaller and the whole helicopter tends to start rotating one way or the other. The yaw pedals [see page 6.7 – Yaw Pedals] are used to counter this tendency.

Cyclic Stick:

The cyclic stick (commonly called 'the cyclic') is mounted centrally in front of the pilot's seat, with a pivot at the base which allows it to be tilted forward, backward and to either side. It is normally held with the right hand, and spring-loaded to a more or less central, upright position.

When you tilt the cyclic away from the upright position, each main rotor blade changes its angle of attack as it moves around the hub. Over half the circle, the angle of attack is greater than the level set by the collective, producing more lift, while over the other half it is less, and less lift is generated. The maximum and minimum points are the same for all blades, so the main rotor's thrust is tilted in the same direction as the cyclic stick itself, the helicopter itself tilts the same way, and starts to move over the ground in that same direction.

Proper handling of the cyclic (especially at low speeds, or in the hover) demands a light touch and intelligent anticipation or the helicopter will slide and wallow about in an apparently endless series of overcorrections. A student pilot's first attempts to hover on the spot will usually have spectators gasping with laughter and alarm by turns – especially in variable winds.

Yaw Pedals:

The two yaw pedals (also called 'torque pedals' or just 'pedals') are mounted in the obvious place for pedals, one at each end of a bar which pivots in the middle. Push one pedal forward and the other moves back by the same amount. They operate on the tail rotor in much the same way that the collective operates on the main rotor, by changing the pitch (and hence the angle of attack) of all the blades at once, thus increasing and decreasing the tail rotor's thrust, or even reversing its direction. As described above, they are used to pivot the helicopter on the spot (a 'pedal turn'), and to keep the helicopter pointing in your chosen direction when the collective is raised or lowered by compensating for the changing strength of the main rotor torque effect.

Pushing on the left pedal turns the helicopter to the left, and vice versa for the right pedal. In this respect they work like the rudder pedals of an aircraft – and in exactly the opposite sense to a bike's handlebars. This can confuse beginners, but practice will quickly sort you out – and it seems to do no permanent harm to your ability to steer a bike.

Putting it all Together

Now that you've been told what each of the controls does by itself, it's time to show how they're used together when actually flying a helicopter. We'll look at the sequence of actions required to take off, transition to forward flight, climb and dive, make gentle turns, slow to a stop and land. Read through the exercise before trying it out for the first time. It is worth emphasising that all your control movements ('control inputs') should be as smooth and deliberate as possible. Sudden, violent control inputs are to be avoided. Make sure that you know where to find airspeed, altitude and vertical velocity readouts on the Head-Up Display (HUD).

1: Taking Off and Rising to the Hover

We'll start with the helicopter sitting on the ground, engines running and rotor spun up to flying speed, in calm conditions. In order to lift off we need to raise the collective slowly and carefully, until we have just enough lift to raise the helicopter off the ground and start climbing vertically. At the same time, we need to feed in some pedal. If we don't do this, then as soon as the weight comes off the wheels, we'll start slewing round on the spot because of the main rotor torque effect. This is one excellent reason for raising the collective gently – the harder you yank on the collective, the bigger the torque effect.

Ground Effect

If you were very slow and cautious in raising the collective, you may find that the helicopter slowly rises a short distance and comes to the hover a few feet off the ground without any change in the collective setting. If this happens, you can congratulate yourself on having demonstrated ground effect. The helicopter is, in effect, riding on an air cushion produced by the rotor downwash. Ground effect magnifies the lifting power available for a given collective setting, but the effect falls off quite rapidly with height, and disappears altogether at a height equal to the diameter of the rotor disc. Rough or sloping ground, violent manoeuvering or strong, gusty winds will all tend to spill the air cushion, push it off to one side, or prevent it forming in the first place, so a wise pilot is cautious about depending on ground effect for the lift needed to stay airborne.

In any case, for our first transition to forward flight we want to climb rather higher than this – say to a minimum of 100 feet/30 meters. As you approach the desired height, ease the collective down slightly and wait to see the effect. Remember that the helicopter has momentum – the faster you were climbing (or descending), the longer it will take for your vertical speed to change till it actually reflects the new collective setting. As you lower the collective, you'll also need to coordinate with pedal input. With practice, you can anticipate the effects of your control inputs, but be careful in the early stages – it's hard to avoid over-correcting.

2: Transition From the Hover to Forward Flight

Once you're above the minimum height and your climb rate is reduced to a low figure (a perfect hover is too much to expect, but DON'T start this exercise while descending!), check that there is a long clear run ahead, with no high obstacles. If necessary, use the pedals to turn onto a clear heading. Now, without changing the collective setting, ease the cyclic a little forward and hold it there, watching the HUD altitude readout. You'll see three effects from this control input:

1) The helicopter tilts forward.

2) The helicopter starts to accelerate forward.

3) The helicopter starts to lose height.

Effects 1 and 2 are easy enough to understand – we're tilting the rotor disc, which tilts the helicopter and directs some of the main rotor thrust forwards, accelerating us forward. The third effect is more indirect, but obviously important. We started in the hover (or very nearly so), with the main rotor producing just enough thrust (directed straight down) to support the helicopter's weight. Now we have tilted the rotor disc (and its thrust vector) in order to accelerate forwards. This leaves less thrust acting straight down to support the helicopter's weight, so it starts to descend. In order to maintain height, we must raise the collective slightly (not forgetting the pedal input), increasing the total main rotor thrust so that its downwards component is large enough to support the full weight of the helicopter. At the risk of stating the obvious, it should be pointed out that this effect applies whenever the cyclic is tilted away from the central position in ANY direction – the further away from the central position, the smaller the lift component.

Translational Lift

As the helicopter gathers speed, you'll find that you start gaining height again. This is due to a phenomenon called Translational Lift, which is hard to explain simply, but is basically due to the fact that the angle of the airflow passing through the main rotor has changed due to the tilting of the rotor disc and the helicopter's motion (translation) through the air. This increases the effective angle of attack of the main rotor blades, producing more thrust. Translational lift appears at quite low speeds, but disappears again with rising speed – and its effects are felt whether the helicopter moves forwards, sideways or backwards.

3: Climbing and Diving

To gain height in a helicopter flying forwards, you can a) pull back on the cyclic, b) raise the collective, or c) use both controls together or in sequence – this is what normally happens. If you just pull back on the cyclic, the helicopter's nose will rise and it will start to climb, but it will also start to lose forward speed – you're redirecting the main rotor thrust so that you have more lift force and less horizontal thrust. Provided that the cyclic is still forward of the central (hover) position, forward speed will stabilize at a lower figure than you started with.

If you simply raise the collective (with pedal input) in forward flight, you're increasing the main rotor thrust without changing its angle, so you have more lift AND more thrust available. The helicopter will climb and accelerate. If you want to climb without losing or gaining speed, you need to pull back on the cyclic AND simultaneously raise the collective.

In a similar (though not identical) way, you can lose height using cyclic input or collective input or both. If you push forward on the cyclic you will lose height and gain speed (more horizontal thrust, less lift). If you lower the collective you will lose both height and speed (less total thrust, so less horizontal thrust and less lift).

Once you appreciate the effects of the controls and have some experience in using them, you can choose the right combination of cyclic and collective inputs to make the helicopter do what you want, up to the limits of performance.

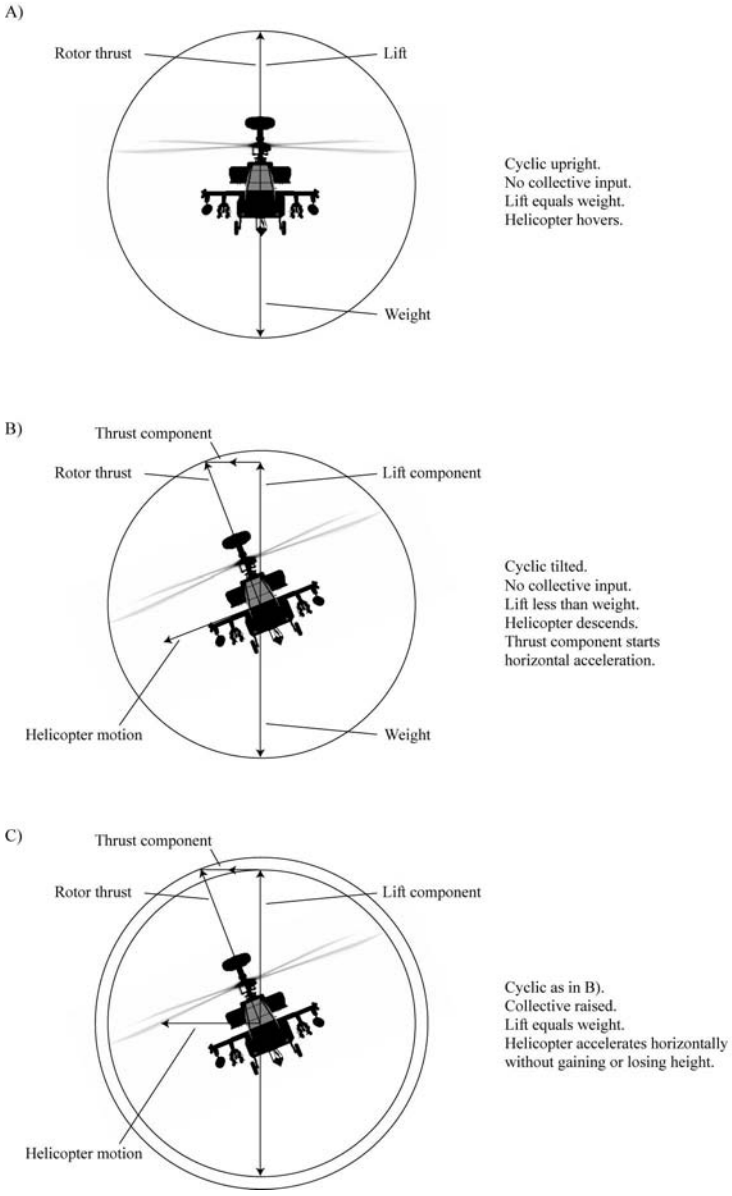


Diagram 6.7: Lift and thrust components

4: Turning in Forward Flight

When the helicopter is hovering or flying at low speed, if you want to turn you do it mainly or exclusively with the pedals. At higher forward speeds, turning is accomplished by tilting the cyclic left or right to bank the helicopter just like a fixed-wing aircraft, though there is no need to use pedal inputs to coordinate the turn. If you fly sustained or steeply-banked turns, however, you'll need to either raise the collective (with pedal input) or ease back on the cyclic, sacrificing some forward speed. If you do neither then you'll lose height because banking tilts the rotor disc (and thrust vector) further away from the vertical, trading off lift for the sideways thrust component which causes the turn [diagram 6.7].

5: Slowing to the Hover from Forward Flight

This technique is called Flaring, and is essentially similar for all wing-borne flying machines, though the helicopter variant is the most complex and demanding since it requires precisely coordinated use of all three controls. The object of the exercise is to slow to a stop in the minimum distance without losing or gaining height. Losing height can be unhealthy for obvious reasons, while gaining height (and exposing yourself unnecessarily) is in military terms 'tactically unsound' – a phrase normally used as a diplomatic substitute for 'lethally stupid'.

Throughout this maneuver you should constantly scan the HUD altimeter/vertical velocity indicator (to see and correct altitude changes) and the view forward (to crosscheck the altimeter and keep yourself heading in a straight line).

You start the maneuver by pulling back on the cyclic to tilt the helicopter backwards – use a moderate nose-up angle to start with, and experiment with steeper angles as you gain experience and confidence. This directs the rotor thrust backwards, which will tend to slow you down, but it also increases the rotor blades' effective angle of attack, and therefore the total thrust – which means that you'll climb unless you simultaneously lower the collective.

As the helicopter slows, main rotor thrust diminishes (slowly raise the collective to compensate), and as you approach the hover you'll need to ease the cyclic forward again to bring the helicopter level, simultaneously raising the collective to the hover setting. [Diagram 6.8] shows the relationship between cyclic and collective movements for the whole maneuver. Pedal is used as necessary to compensate for collective movement and to keep the helicopter straight.

6: Landing Problems and Techniques

Though we've just gone through the Flare maneuver, with the emphasis on slowing to the hover without gaining or losing height, this technique generally needs modifying to convert it into a sensible approach to a landing. The reason for this is that unless you're already flying very low indeed, the flare will leave you hovering higher than you want to be for a safe and sensible vertical descent to touchdown. The problem is mainly one of visibility, and is particularly acute in combat helicopters.

Visibility Factors

In a combat helicopter with a classical crew arrangement (gunner in front of pilot, both on

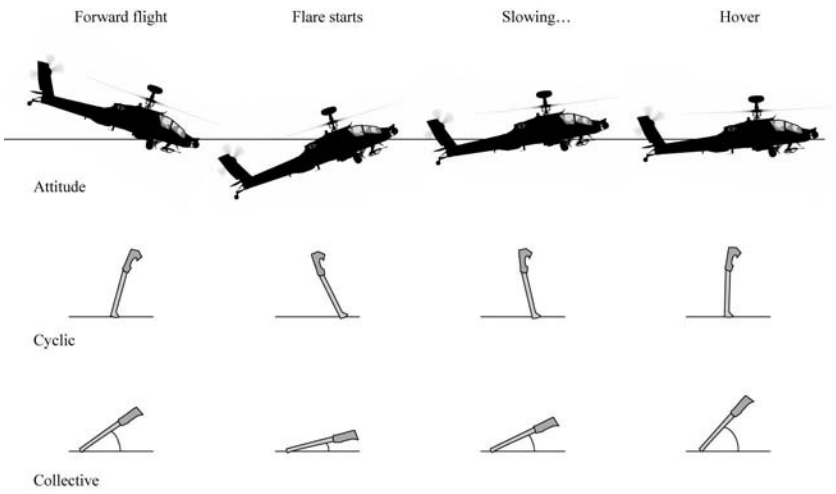


Diagram 6.8: Coordinating cyclic and collective in the flare

the centerline), you as pilot have an excellent field of view to either side. Your forward view is restricted by the gunner's cockpit and the length of the nose in front of you (more of a problem in the hover or the flare than in forward flight), and your view behind is obstructed to either side by engine pods, stub wings and armament and totally obscured directly behind by the solid bulk of the fuselage. You have no view at all straight down, so whenever you're descending vertically you are effectively exploring the unknown, tail-end first. It's a lot like trying to sit down in the dark in an area infested with scorpions.

You need to touch down at a chosen point on a reasonably smooth, level surface, preferably without striking anything with your main or tail rotors. A combat helicopter's main rotor system is amazingly robust – it's designed to support tons of helicopter through violent maneuvers and shrug off cannon shells. If you're prepared to explain the damage to your maintenance crew and superior officers you can chop down small trees with it and still fly away. The tail rotor, however, is smaller and inevitably more delicate. It also projects further beyond the main rotor disc than any other part of the helicopter, and it's right in the middle of your blind spot behind.

Though you can largely compensate for the restricted view by doing pedal turns, and by picking visual reference points on either side, descending vertically from a high hover is usually far more trouble than it's worth [see also page 6.20 – Vortex Ring Effect]. The normal helicopter landing approach is very much like a fixed-wing aircraft's, until you reach the final stages.

Circuit Pattern

The obvious conclusion is that whenever you're landing in an unfamiliar area with potential hazards and obstructions you should always check it first. The standard technique for doing this is to fly a 'circuit' [diagrams 6.9 and 6.10].

The first piece of information you need is the wind direction and if possible its strength and gustiness. You may know this already, it may be provided for you by someone on the ground with a radio (or a set of marker panels), or if not then you can usually observe it for yourself by looking for drifting smoke, flags or other such clues.

The reason why wind direction is important is that you should try to land with your nose pointing into the wind. While this is a nearly inviolable rule for fixed-wing aircraft because it reduces speed over the ground and the length of the landing run, helicopter pilots have more choice in the matter [see page 6.18 – Sideways]. Nevertheless, your life will be easier if you can land facing into wind.

The wind direction (or the layout of the site) establishes the direction of your landing approach, and the orientation of the circuit pattern. Use the downwind and base legs of the circuit to inspect the landing area and reduce your height and speed. As you pass the touchdown point on the downwind leg, look for visual reference points on either side which you can use to locate yourself once the touchdown point has disappeared under your nose.

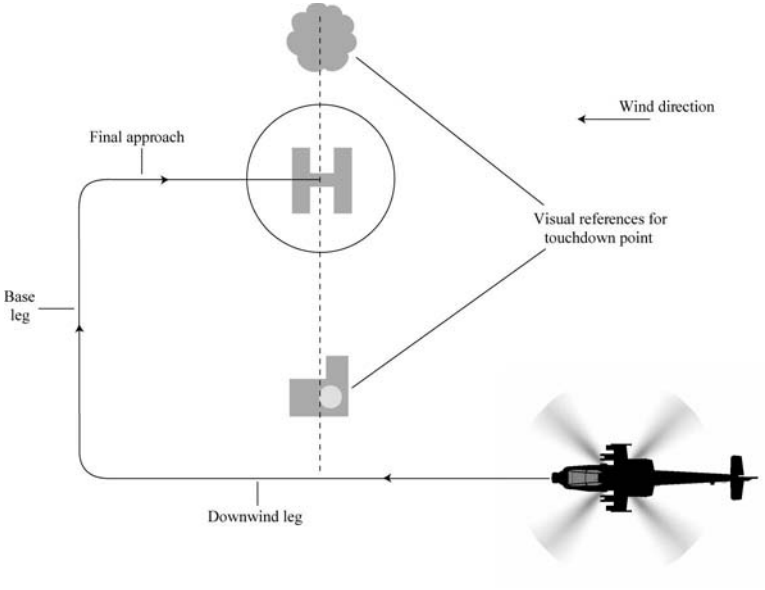


Diagram 6.9: Circuit pattern for a clear landing area

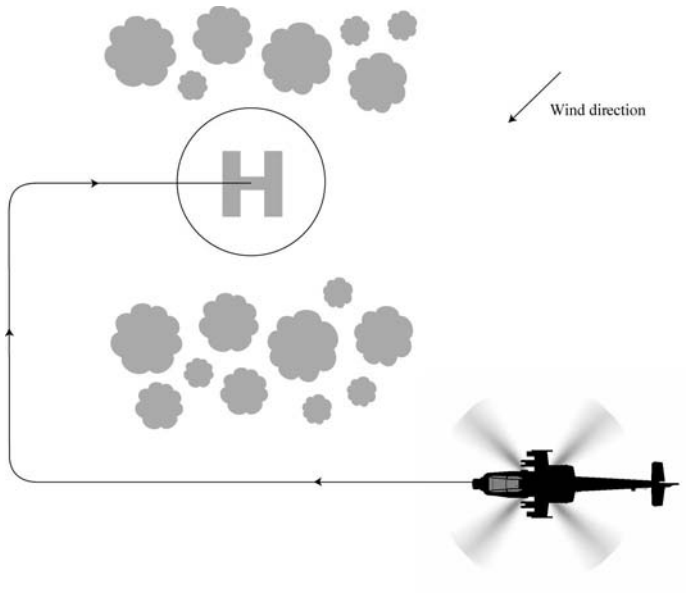


Diagram 6.10: Circuit pattern for an obstructed landing area

The size of the pattern, your entry height and speed should be determined by the size and nature of the landing area, and the likelihood of enemy action. If the landing site is large and unobstructed (and the enemy isn't watching or shooting) then you can afford a large circuit, entering high (say 500-1000 feet/150-300 meters) and at relatively high speed. If the landing area is cramped and obstructed, or you wish to avoid enemy attention, you should fly a much smaller, tighter circuit, entering at lower speed and altitude.

Final Approach

You should ideally make your final descent towards the touchdown point with the helicopter as nearly level as possible. Avoid pushing the collective forward to dive at the ground, and try to ensure that by the time you reach this stage you're travelling slowly enough that a very moderate flare – or ideally a constant slightly nose-up attitude – will be enough to bring you to the hover a few feet above your touchdown point. Now all you have to do is gently lower the collective and touch down.

If you find yourself too high and/or too fast on the final approach, you should abandon the landing and go around again [diagram 6.11]. If you attempt to kill off speed using a radical flare at low altitude then you risk striking your tail rotor on the ground. If you try to descend at too steep an angle from an excessively high approach then you'll suffer from all the

visibility problems we discussed earlier, plus running the risk of Vortex Ring Effect [diagram 2.14]. Just raise the collective to arrest your descent (or climb if there are obstacles to clear), fly on over and past the touchdown point, and turn into another circuit – smaller, lower and slower than the first. Keep it in mind that you'll find it much easier to establish the second circuit if you continue some way along the approach line past the touchdown point before you turn.

We Don't Need no Stinking Circuits!

Oh yes, you do. It's not just a piece of textbook ritual. The procedure described above may seem formal and longwinded but it really is useful. Not only does it give you the chance to scout the landing area, but the sequence of legs and turns lets you judge and adjust your speed and rate of descent relative to the touchdown point – and the turns can be used to kill off a great deal of speed. A straight-in approach looks much simpler and is perfectly practical for landing in the middle of a wide open airfield, but as soon as you have to deal with obstructions and previously unseen landing sites, the circuit pattern is much safer, usually faster, and saves a great deal of wear and tear on your nerves.

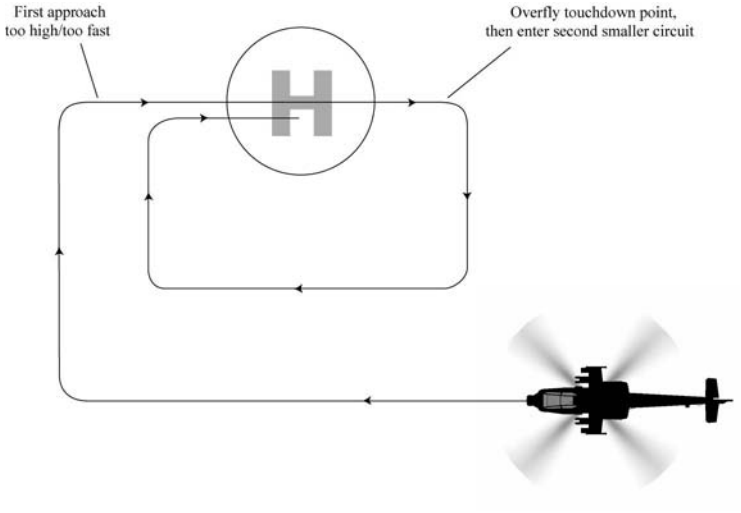


Diagram 6.11: Going around again

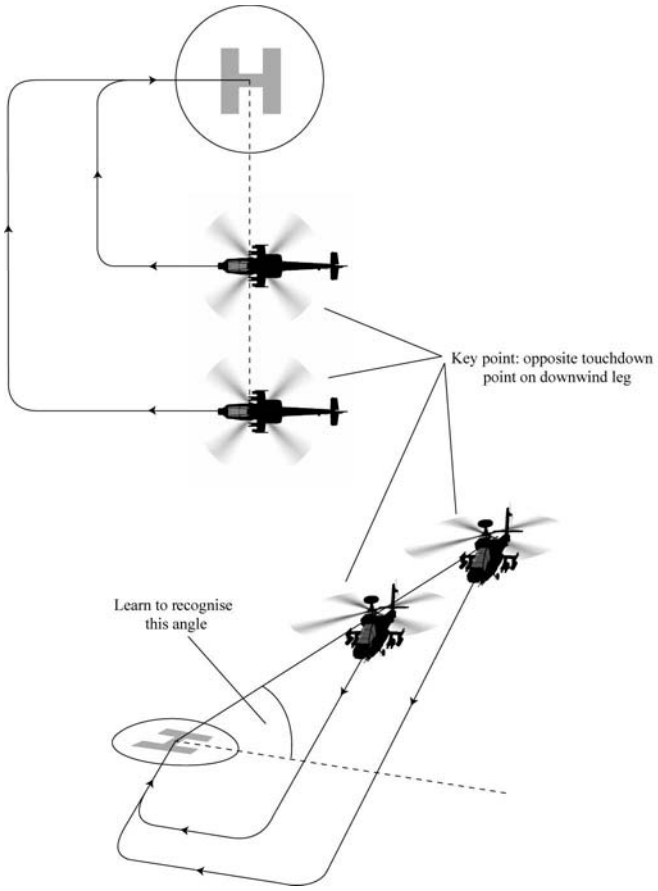


Diagram 6.12: Judging offset and height in the circuit

The key to a successful circuit of any size is to select the correct combination of height and lateral offset (between downwind and final legs). This can be done by learning to recognize the angle, or range of angles, you see when you look down on the touchdown point from the downwind leg. This skill, like any other, can only be acquired by means of practice.

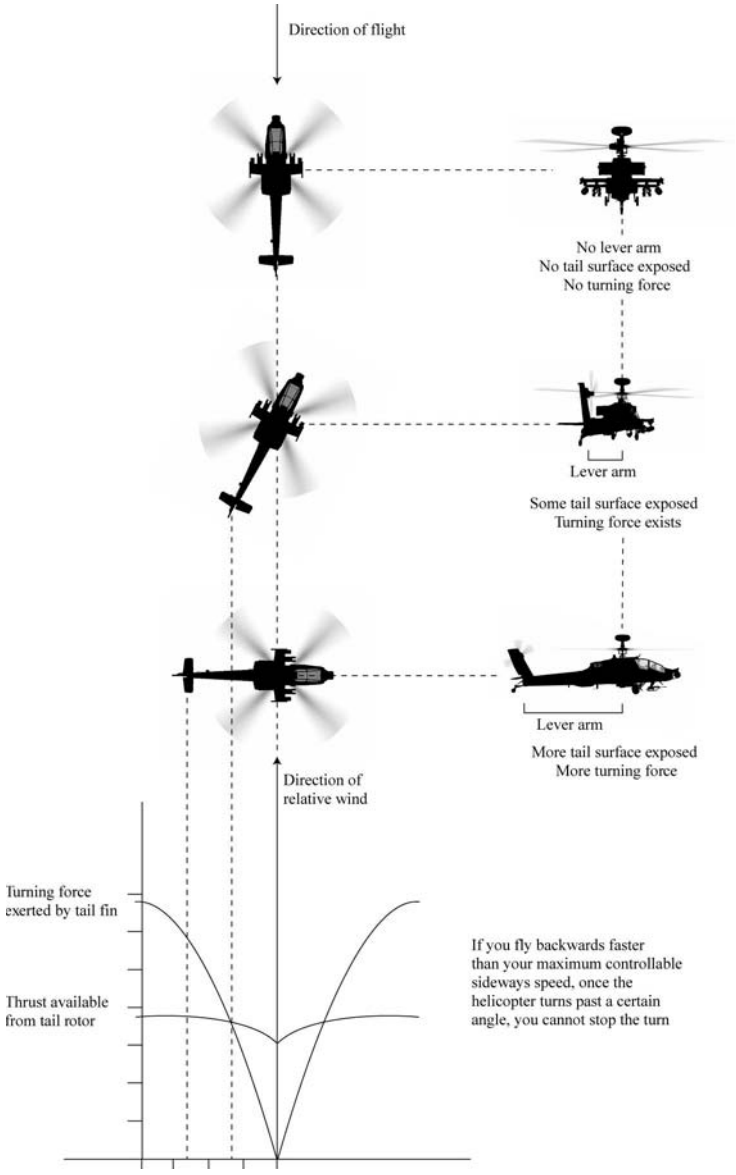


Diagram 6.13: Turning forces in backwards flight

Sideways, Backwards and Crosswinds

If you have absorbed and understood the basic principles of helicopter flight it should be obvious that you can fly the helicopter in any direction from the hover, without turning, by tilting the cyclic the way you want to go. You can also hover on the spot in a wind blowing from any direction by tilting the cyclic into the wind. There are, however, a few pitfalls which should be pointed out.

Weather-Cocking

The helicopter's tailboom is there for two main reasons. We've already mentioned that it provides a convenient mounting point for the tail rotor, outside the worst of the main rotor downwash, and at the end of a long lever arm. Those same factors also make it the best place to mount a vertical fin (or fins) very like what you find at the tail end of most fixed-wing aircraft, and serving exactly the same purpose; to provide automatic directional stability in fast forward flight, just like the fletching of a dart or an arrow.

The tail fin works against you when you try to fly sideways or hover in a cross-wind, generating a force which tends to turn the helicopter's nose into the relative wind. The whole helicopter acts like a weather-vane. To counter this effect you must use pedal inputs – and the faster you fly (or the stronger the crosswind) the larger the input needed to maintain heading. Eventually you'll reach a point where the tail rotor simply cannot provide any more thrust, and the nose will inexorably turn into the relative wind. This is one of the main reasons why a helicopter's maximum sideways speed is much lower than the maximum forward speed – and a wise pilot will always try to avoid flight regimes which can only be maintained by jamming any control hard against its stops.

Stability in Backwards Flight

Backwards flight is something that obviously needs to be done carefully – you can't see where you're going, and you're flying tail rotor first. There are less obvious problems which affect you even if you have unlimited space for maneuver, or if you're simply trying to hover in a strong tail-wind. The explanation involves some basic physics, but the diagram should help you grasp what's going on.

The strength of the turning force generated by the tail fin depends mainly on three factors:

1) The speed of the relative wind.

2) How large a surface the tail fin presents to the relative wind.

3) The effective length of the tail fin's lever-arm with respect to the relative wind and the helicopter's center of mass, which we can assume will be more or less directly under the main rotor hub.

Taking these factors in order; 1) more airspeed means more force. In fact, because the force is proportional to the square of the airspeed, a little more speed means a lot more force. 2) When the tail is pointing straight into the wind, it is exposing the least possible area and generating the least possible force. As the tail swings out across the wind, it presents more and more surface area, generating more and more force. 3) When the tail is pointing straight into the wind, it is in line with the center-of-mass and there is no leverage. As the

tail swings out across the wind, the length of the lever-arm increases and so does the turning force. Factors 2 and 3 both reach their maximum when the helicopter is broadside-on to the wind, as it is when you're flying sideways.

Because the tail fin exerts no turning effect when pointing straight into the relative wind (and the helicopter's fuselage is generating little or no more drag than it does when flying forwards) it is possible to accelerate to much higher speeds in backwards than in sideways flight.

The catch comes when the tail turns out of line. The moment any turning force is generated, it tends to turn the helicopter even further off the wind, generating even more turning force, and so on in a vicious circle. At high speeds this happens so quickly that you have very little time to correct the swing, and if you are moving faster than your maximum stable sideways speed, once the swing goes beyond a certain point you don't have enough tail-rotor thrust to stop it anyway.

At this point you've lost control of the turn, which is almost exactly like a handbrake turn or U-turn in a car. The helicopter swaps ends in an instant, the main rotor blades flap and thrash madly, and if you're lucky they don't smash the cockpit canopy or chop off the tail boom as the rotor disc tries to re-align itself with the suddenly and violently changing attitude of the rotor mast.

It is possible (and even potentially tactically useful) to perform milder variants of this manoeuvre under control, but work up to it cautiously. Approach it as you would approach the problem of performing a backflip while whirling a sharp sword around your head.

Hazards and Emergencies:

Landing on Slopes

When necessary, it is entirely possible to land safely on a smooth moderate slope, but the technique needs practice. Though at first sight it might seem natural to land facing up the slope, the preferred direction is sideways, facing into the wind. If you don't think the helicopter will be stable standing across the slope, then the slope is too steep, and you must find somewhere else.

Approach as normal, but slow your final descent so that you hover with your uphill wheel just touching the ground. Now very gently lower the collective, and as the helicopter leans, move the cyclic in the opposite direction so that the rotor disc remains horizontal. Once both wheels are on the ground, carefully lower the collective to transfer the weight to the wheels, keeping the rotor disc horizontal, to oppose the pull of gravity, rather than tilting it to match the cross-slope.

Take-off can be accomplished by simply reversing the landing drill. The important things are to keep the rotor disc horizontal and to use a very delicate touch on the collective when the wheels are on the ground.

Retreating Blade Stall

We have already talked about the difference in lift developed by the advancing and retreating blades of the main rotor in horizontal flight, which is due to the difference in their effective airspeeds. Lift is directly and sensitively proportional to airspeed, but for any given

wing at any angle of attack there will be a critical speed below which lift suddenly collapses – the wing stalls. For any reasonably powerful or streamlined helicopter, the maximum safe airspeed is determined by the speed at which the retreating rotor blade starts to stall.

In this situation, you suddenly start to lose lift on the retreating blade side, and the helicopter rolls towards it. Provided that you are not diving too steeply, you may be able to reduce speed by lowering the collective and pulling back on the cyclic before you lose control, but beware of violent panicky maneuvers, which may stall more blade area or set the blades flapping violently.

Like all aerodynamic effects, retreating blade stall is affected by air density and by temperature. It will happen at lower speeds at higher altitudes and/or higher temperatures.

Vortex Ring Effect

The commonest visible example of a vortex ring (or ring vortex) is a smoke-ring. In fact they are quite a widespread phenomenon, but like all flow patterns they are usually impossible to see directly. All you need to start one is a stream with a more or less circular cross-section (like your rotor downwash) which satisfies certain other conditions.

In a helicopter, you can unintentionally create a vortex ring around your main rotor if you make a sustained high-speed descent vertically or at a steep angle. Once the ring has formed, it is surprisingly stable, and moves with you as you descend. The extra downwash

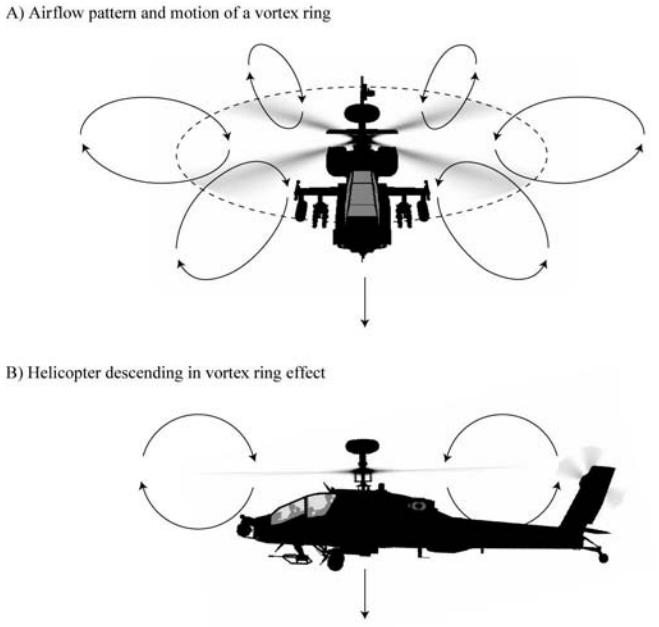


Diagram 6.14: Vortex rings

of the circulating vortex ring destroys most of the main rotor's lift, and you cannot escape by raising the collective – you will only pump energy into the ring's circulation. You are already descending too fast to escape downwards and outrun it. The only way out is to use the cyclic to move laterally, because lateral movement disrupts the vortex, just as vertical movement maintains it.

Coping with Reduced Power

If you lose an engine in a powerful twin-engined helicopter like the Comanche or the Hokum you can still fly, land and take off, provided that you don't try to lift heavy weights in hot and high conditions or leap tall buildings at a single bound. The keys to achieving this are translational lift and ground effect. Every time you raise the collective for more lift you put more strain on the surviving engine, and the rotor speed may slow to dangerous levels.

Ground effect multiplies your main rotor lift and may let you hover with reduced power. It also provides a convenient low-friction environment in which to accelerate to a speed where translational lift can let you climb out of ground effect. When approaching for a landing, or descending and decelerating for any other reason, let yourself gently down at a shallow angle or a low speed, or both. The ground effect cushion is no deeper than your main rotor diameter.

If you cannot even hover in ground effect, you may still be able to achieve a running landing, if space is available. The approach is flown very like a low speed approach to a runway in a fixed-wing aircraft. Just as in an aircraft, you round out your descent by pulling smoothly back on the cyclic before you touch the ground so that you kiss it gently rather than crash into it at an angle. At the same time you must avoid plunging your tail-rotor into the ground.

If you're running out of horizontal speed but close to the ground you can probably afford to raise the cyclic to slow the last seconds of descent. If you run out of forward speed and rotor rpm at the same time, you'd better hope that you don't have too far to fall.

Running takeoffs are also possible if space, surface and wind direction permit. The idea here is to accelerate on the ground to a speed where translational lift will let you lift off and (you hope) climb. If you can't climb out of ground effect then you need a clear run to a lower altitude, or another rolling landing. Failing these, you're in trouble.

Autorotations

If a helicopter loses all engine power in flight, it can still be landed without serious damage or injury provided that the pilot does everything right, and there is a clear space in the right place for a landing. The technique and options vary according to your height when power is lost.

1) Loss of Power at Altitude

The standard Autorotation procedure assumes that the helicopter is flying at 500 feet / 150 meters or more. The key technique is to preserve the rotational energy stored in the main rotor system (treating it as a giant flywheel) until it can be used up in the last few seconds of flight to halt your descent and lower the helicopter more or less smoothly to the ground.

Two steps are essential to accomplish this. In the first place, as soon as the engine thrust disappears you must instantly bottom the collective, which reduces the main rotor pitch angle to its lowest value and minimizes the drag on the rotor blades. At the same time, if you have the height and space to maneuver, you should try to preserve the helicopter's forward motion and minimize the rate of descent by using the cyclic to trim your speed to the minimum-rate-of-descent figure – about 70-80 knots/130-150 kmh. The resulting airflow will actually drive the main rotor around, just as it does in an autogyro (which has a powered propeller to give it forward speed, which drives its unpowered rotor). This is what the word Autorotation means. It is to a helicopter what gliding flight is to a fixed-wing aircraft.

Unfortunately, a heavy combat helicopter glides about as well as a fast jet does. Because of the low speeds involved, and the rotor's ability to deliver braking thrust straight down, it is still possible to land safely, but a very steep descent may be required to keep the main rotor turning. Your pull-out/round-out maneuver must be finely judged to avoid either hitting the ground in the dive or finding yourself running out of airspeed and rotor rpm with the ground still an uncomfortable distance below.

At the same time as the collective is bottomed and the cyclic trimmed, the pilot must also scan the area below and ahead (and preferably upwind) for the best place to put down and steer towards it. There is no time for hesitation or indecision in this sequence unless you have a great deal of height to spare. Action and decision must be nearly instantaneous, and once you've made your choice of landing area you are committed.

2) Loss of Power at Low Level

This is a more likely scenario for an attack helicopter than the classic autorotation described above. Your options are essentially limited to flaring more or less straight ahead, and/or raising the collective to convert rotational energy into braking thrust before you hit the ground. The helicopter will probably take severe damage, but its structure is designed to absorb energy and protect the crew in precisely this situation. Combat helicopter crews can expect to survive crashes which would be instantly fatal in most kinds of aircraft.

Tactical Flying

The most important, most fundamental piece of advice for a brand-new attack helicopter pilot who knows more about fast jets than ground combat is to stop thinking like a fighter pilot and start thinking like an infantryman or a tank commander. Cover, vantage points, fields of fire, and lines of retreat are everything. Fly high and fast in the neighbourhood of the enemy and you simply expose yourself.

Unless you are planning a slashing surprise attack on a known enemy position, every time you come to a skyline which may expose you to an enemy on the other side you should either avoid it or creep up to it and peer cautiously over the top. A pair, or a larger unit of attack helicopters advancing to contact with the enemy should ideally leapfrog forward in the classic pattern of advancing infantry; one group holds position at a point which combines cover with good fields of view and fire, while the other group scuttles forward to the next vantage point, to cover the next advance.

Withdrawal or retreat is also usually handled the same way, with one group providing covering fire, or at least attracting the enemy's attention while the other group concentrates on falling back to the next available cover while minimizing their own exposure.

Security: Cover, Speed and Maneuver

Using Cover

Crests, valleys, forests, rivers with steep or wooded banks, sunken roads and buildings can all provide cover. At the personal level and on a small scale, everyone who has ever played hide-and-seek understands the concept well. The difference between this and the military concept of cover is mainly one of scale. Hiding yourself is rarely difficult in any normal environment. Hiding troops, vehicles or helicopters requires the use of much larger obstacles and, especially, landscape. For a helicopter there is no better form of cover available than high ground between you and the enemy.

When you know roughly where the enemy is, it is not too difficult to identify the 'dead ground' which he cannot see or sweep with fire. These are the areas you can use to approach, to launch an attack, to hide, or to retreat safely. If the terrain favors you, and you exploit it

properly, you may be able to approach, attack and withdraw without exposing yourself for longer than it takes to fire.

On the other hand, there may not be continuous cover between your current position and the place where you want to go next. If the target is stationary you need to get closer, you must now risk exposed dashes between dead zones. If the target is moving, however, its dead ground changes rapidly, and if you can predict how it will change, you can often use broken cover as effectively as the continuous kind.

Valleys and depressions are the best places to find dead ground, since they can shield you from view all around, or at least over wide angles, but the same is obvious to any competent enemy, and roads often run down valleys. Cover is valuable to everyone, and the enemy may have got there first.

Obstacles like hills, woods or groups of buildings provide a different sort of cover. If the enemy is moving, you must move around your cover to stay behind it. Clearings in woods, or open spaces surrounded by buildings, can be considered as shallow depressions or valleys.

Moving from cover to cover may be the safest way to advance, but it doesn't guarantee complete safety. Whenever you expose yourself, consider what you can do if the enemy appears over the horizon at the worst possible moment.

Using Speed and Maneuver

If you don't have cover, then the next best things are speed and agility. A helicopter stationary in the open is an easy high-value target. A helicopter flying slowly, or in a straight line, is not much harder to hit. If you must expose yourself to enemy fire, try to build up speed before you break cover, and fly a tight three-dimensional zigzag. Don't just put your head down and run; change your path every few seconds. The gain in safety under fire is well worth the minor loss of speed. If you must fly straight, to line up for an attack with unguided rockets, for example, then try to zigzag vertically. The vertical zigzag is your best tactic against radar-directed gunfire from any direction except close ahead and behind.

Offensive Tactics

Just as there are two basic forms of defence; cover on the one hand, maneuver on the other, there are two corresponding modes of attack available to a combat helicopter; Sniping and Slashing. Each has its advantages and disadvantages. Be prepared to use both, and to switch rapidly from one mode to the other.

Sniping Attack

This method is usually the safer of the two, especially against a numerous enemy. As the description suggests, you set yourself up in cover and expose yourself only as much as is necessary to pick your targets and fire, though if you're using the older-model laser-guided Hellfire in the Comanche, or the laser-guided Vikhr missile in the Hokum, you will have to stay exposed long enough to keep your sights on the target until the missile reaches it.

If you don't have a fire-and-forget missile available, this means that in some ways you're safer sniping from close range. The missile flight time is shorter, and so you are exposed

for less time while you guide it.

The best way to use this technique at the individual level is to fire a single missile, or a short salvo, duck back into cover, and move to a new position before popping up (or sideways) to shoot again. If two or more helicopters cooperate, taking turns to attack from widely separated positions, the technique is even more effective.

At a slightly higher tactical level, the sniping attack is also a relatively low-risk way to grab the enemy's attention and focus it in one direction, while a second force approaches to strike from a fresh direction, preferably the enemy's flank (side) or rear.

Slashing Attack

Used properly, this technique resembles a cavalry charge, or a firing pass by a ground-attack aircraft. As noted above, as the range closes your weapons' flight time grows shorter, and your unguided weapons also become more accurate. If you can surprise the enemy and make your run from an unexpected direction, you will have a vital few seconds - how

long depends on the enemy's state of readiness - before sensors and weapons can be re-oriented against you. You must make the most of this grace period to take out the enemy's most dangerous air defense systems.

Another vitally important question to consider is what happens at the end of your run. If you do not succeed in suppressing the enemy's air defense systems, then you will need to find cover quickly. Don't even think about turning round and retreating to your starting position - you must keep your speed up and open the range as fast as possible, dodging as hard as you can.

As ever, intelligent cooperation can vastly increase the effectiveness of the tactic, and reduce the risks. If several helicopters attack from different directions simultaneously, the enemy must divide the available defensive fire between them. Another tactical variation worth considering is to attack in a series of waves. As the first wave passes the enemy's position and the defenses swing to follow them, a second attack wave may enjoy a few seconds of immunity while the defenses re-orient against them - and this also takes the pressure off the first wave as it retreats.

A well-executed slashing attack can be devastating, but used wrongly, this tactic will devastate your own forces. The classic example of the wrong way to take the offensive comes from the mass infantry attacks of the first world war. If the enemy knows where you're coming from; if his weapons are already pointed in your direction; if his forces are behind cover while you must cross open ground, then you are inviting disaster.

Another situation where the basic principles of the slashing attack are important is the unexpected engagement. If you must cover ground quickly, and a cautious leapfrog advance is not possible, then every time you cross a ridgeline or come around a bend in a valley you may find the enemy in your path. Unless he saw you coming he'll be just as surprised as you. If you have the weight of fire to do him serious damage, or there is cover available beyond, a hasty slashing attack may be the best form of defense - your fastest way out of a dangerous situation.

Defensive Tactics

In those cases where attack is not a practicable form of defense - when faced with superior forces in open ground, for example - the first essentials are cover and a line of retreat. Ducking into cover without a line of retreat amounts to trapping yourself. Mobility is the helicopter's prime asset, and its only defense against area weapons like large blast warheads or submunitions clusters. Remember that when the enemy knows where you're hiding he can attack you with mortars or artillery, even if you are out of sight, or outflank your position by advancing around it, either with ground forces or other helicopters.

The only guaranteed counter to a properly executed flanking maneuver is to retreat. If you don't have the space and the cover to do this, then outside intervention may be your only hope. The moral of the story is simple - keep your line of retreat open, especially in a sniping engagement. If it is threatened by enemy movement, use it straight away while you still can. If you know in advance that you're going to have to make a fighting withdrawal, pick out in advance the places where you can turn and fire back at your pursuers, and be aware of places where you can find friendly fire support. Lead the enemy to them if

possible.

Air-to-Air Tactics

If you have to fight another combat helicopter, or an aircraft, remember the mantra "this is not a jet fighter". To a fighter pilot, altitude is a resource, a source of potential energy to be converted into speed. To you, as a combat helicopter pilot, altitude means exposure to enemy ground fire. Speed, too, works differently for a helicopter pilot. If an enemy aircraft makes a high-speed slashing attack on you while your own speed is low, the advantage swings to you as soon as the enemy is past. He is the prisoner of his own momentum, you can pedal-turn and launch your own weapons from his blind spot.

Use cover and ambush tactics when the enemy is chasing you. When you're chasing him, beware of the same tactics. Some classic air-to-air doctrines still apply to helicopter combat; If you're part of a formation attacked by enemy helicopters, the formation should split up. At the least, the enemy must divide his forces to pursue the different elements. If the enemy leaves any of your elements unengaged, these should then turn around and come in on the enemy's own tail.

Another classic air-combat tactic that may work for you is turning towards your opponent's approach. This brings your own weapons to bear and shortens his firing time.

Using Ground-attack Weapons in Air Combat

Even if you're not carrying specialized air-to-air missiles, you should be aware of the anti-aircraft potential of your ground-attack weapons. Cannon, rockets and anti-tank missiles may all be usable, if less than ideal. If you have to use these weapons against aircraft, try to do it at short range, and set up a low-deflection shot from ahead or behind. Remember that your guided weapons may fly a pursuit path to the target, rather than an intercept path, which reduces their effective range. Anti-tank missiles also generally have lower acceleration and top speeds, higher drag, and much less agility than anti-aircraft missiles - launching a Hellfire at a passing or retreating fast jet is most likely to achieve nothing more than the waste of an expensive missile.

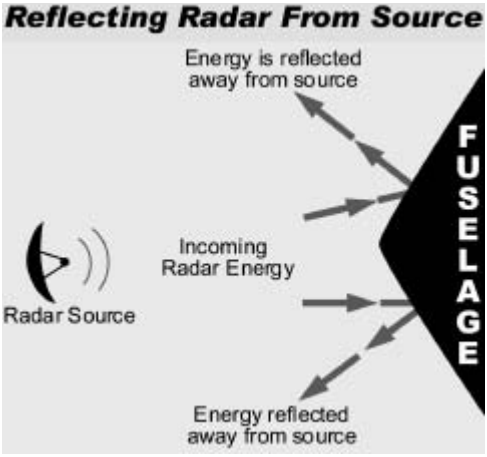

COMANCHE VERSUS HOKUM

RAH-66 Comanche

Carrying on the design tradition of American attack helicopters with the tandem cockpit and turreted nose cannon, the RAH-66 Comanche also brings a suite of new technologies shaped to fit the US Army's 21st century vision. It is a vision often described using terms such as efficiency, economy, flexibility and rapid-deployment. With the reduction of military strength after the cold war and the increasing involvement of the US Army in "Operations Other Than War", it has become evident that future forces need to be of a higher quality. They need to deploy anywhere in the world rapidly and win in combat with the minimum number of casualties.

Combining systems initially developed for the Apache and Light Helicopter Experimental (LHX) program with new high-technology systems, the Boeing Sikorsky RAH-66 Comanche represents the state-of-the-art in attack helicopters.

Visually, the most striking feature is the exterior body shape. Using what is known as low observable (LO) properties, the fuselage is designed to reflect radar energy away from any transmission source. Boeing claims the radar signature is around 1/300th of current aircraft. To maintain a low radar profile, stores can be hidden in IRAMS (Integrated Retractable Munitions System), this is an internal weapons bay capable of holding 6 Hellfire missiles.



Mounting stores internally in such a way prevents any radar energy being deflected back off the weapon and thus increasing the helicopter's radar cross section (RCS). Should the mission profile call for firepower over stealth then additional weapons may be fitted under removable wings. A total of 14 Hellfire missiles can be fitted in this configuration.

The Comanche has an advanced bearingless composite rotor with swept blade tips that reduces its acoustic signature, particularly at the reduced RPM levels of the so-called "quiet" flight mode. The low-noise rotor system, reduced infrared exhaust and small radar cross-section make the Comanche the stealthiest helicopter in the world. While not invisible to radar it is much harder to detect at longer ranges.

Sensors are mounted on the nose and top of the rotor mast in a similar configuration to the AH-64D Longbow Apache. Indeed the RAH-66 boasts the next generation Longbow radar system that is half the size of the previous model fitted to the Apache D model. Mounted on the nose is a second generation FLIR (forward looking infrared), this has double the resolution of the FLIR pod fitted to the Apache. This second generation FLIR permits more reliable target recognition at 40% greater range. With 100% greater resolution and 35% greater field of view, it is much safer for night flying which should give some comfort to the crew.

In populated regions the greatest threat to a helicopter operating at night comes from suspended or overhead cables. Whenever conventional helicopters are lost or damaged it is usually through a cable strike. The improved FLIR can resolve cables that have small currents running through them; electrical currents heat up wire to a point where they begin to "glow" by a small amount in the infrared spectrum. To further reduce the risk of wire strikes, the Comanche is fitted with a wire detector that provides an audible warning should it stray too close to a current carrying cable.

Flying the AH-64 Apache using the PNVS (pilots night vision system – presented via a helmet mounted monocle) has been described as, "trying to fly a helicopter by looking through a drinking straw". The RAH-66 comes with a 53° wide field of vision holographic helmet mounted display system and is biocular. Called HIDSS, the Helmet Integrated Display and Sight System delivers FLIR sensor, flight and targeting symbology to both eyes. As in the Apache, weapon targeting can be slaved to the pilots' helmet movements. Wherever the pilots look, the helicopter sensors will follow. In addition to this, the chin mounted 20mm GIAT Vulcan-II cannon can also be slaved to follow the pilots' head movements. When not in use, the cannon is normally stowed in a LO cowling positioned under the chin.

Front and rear cockpit configurations are near identical. The fly-by-wire flight control system is triply redundant, the cyclic side-stick includes a twist action which controls aircraft yaw. When used with flight assist modes the Comanche can be flown with just one hand. This makes the Comanche a remarkably easy aircraft to control.

The cockpit is over-pressurized to prevent any possible crew contamination from NBC - nuclear, biological or chemical agents. Should the cockpit suffer a minor breach after an attack the positive cabin pressure will prevent any contaminant invading the crew area.

On-board computing power is equivalent to four super computers, however only 10% of this power is needed to fly the aircraft; the rest is utilized in a highly advanced mission equipment package. For target acquisition, there is automatic visual and radar target recognition. Depending on the orientation of the target to the sensor, the computer can distinguish not only between wheeled and tracked vehicles, but also determine vehicle type. It has the remarkable ability of recognizing the difference between an M1 Abrams and a T-80.

EO sensors can be set to visually scan a crew-designated sector and automatically classify and track high-priority targets detected within that sector. Target removal is via man-in-the-loop battle damage assessment, if a target has been hit and destroyed, the operator is required to confirm destruction before it is removed from the tactical picture.

Sensor information can be shared with other elements of the combined arms team via a "tactical internet". Command & Control (C2), ground forces, JSTARS, AWACS, indeed any compatible system can exchange correlate and share tactical information with the Comanche systems. Supported protocol stacks include; AFTDS, AFAPD, TACFIRE, VMF, and MTS. Other tactical information distribution systems can be easily incorporated.

For communications, an existing system known as Air Force Integrated Communications Navigation Identification Avionics, is used for interoperability. In addition there are two VHF-FM single channel ground and airborne radio systems, a VHF-AM radio set and a HF (high frequency) radio for non-line of sight communications. An IDM or Improved Data Modem is used for communicating with the tactical internet.

Mission planning and rehearsal can be done completely in-cockpit using the advanced "Tactical Mode". Digital terrain maps provide elevation and feature data, which are optionally overlaid with a tactical situation display then rendered in plan or a real-time 3D perspective view. The map can be overlaid with threat forces, friendly positions, waypoint information and calculate intervisibilities. It can be used for threat avoidance or enroute mission planning. Positional information comes from a composite GPS/Doppler/Inertial navigation system that is constantly cross-checking and updating itself.

Each processor is an easily replaceable module common to the Air Force and Navy. If a module should fail, the systems reconfigure themselves allowing the Comanche to remain in battle and continue its mission despite malfunctions or battle damage.

Analysis of conducted exercises have shown that maneuverability, rate of climb, tandem (instead of side-by-side) cockpit configuration and a turreted gun are winning combinations in head to head helicopter engagements.

Development History

Back in 1981, a plan was drawn up for a single basic utility helicopter called LHX (Light Helicopter Experimental). The intention was to replace the aging UH-1, OH-58 and AH-1 fleets with a production run of 5,000 LHXs. To fulfil the diverse mission roles currently undertaken by the existing fleet, different LHX models were to be equipped with a large variety of new technologies and mission equipment packages. While it was considered to be an expensive program, military spending was generous under the current administration. Six years later in 1987 these mission roles were substantially reduced to scout and attack only. The projected LHX requirement then fell to around 2,000.

The upgrade/replacement program needed a rethink and quite possibly a different helicopter better suited to the narrower mission profile. In 1988 the Department Of Defense issued a "Request for Proposals", the request received a rapid response from Boeing Helicopters in collaboration with Sikorsky Aircraft.

In 1990, the projected number of new helicopters required was further reduced to 1,292 with an option of a further order of some 400. A year later, the Boeing Sikorsky partnership was awarded a contract to build 4 prototypes, designated the RAH-66 (RAH being an acronym of Reconnaissance Attack Helicopter).

Modernization programs for the Apache and Kiowa were started with a view to enhance real-time intelligence gathering and distribution capabilities. These programs helped shape Army XXI's view of the electronic battlefield and have in-turn influenced Comanche systems specification.

A combination of cost reviews and specification changes initially resulted in patchy development. At present, the Boeing Sikorsky team manages some 1,100 major subcontractors and suppliers across the United States, quite a feat of co-ordination. Recent successes with two flying prototype Comanches have been good news for the program. The U.S Defense Department has approved an early operational capability program, which will provide six additional aircraft to the U.S Army so they can begin operational testing. These new aircraft will be manufactured in 2001.

Meanwhile, digitization programs of OH-58 Kiowa and AH-64D Apache continue, results suggest both platforms can be integrated more closely with ground forces than previously thought. They will integrate well with the Comanche when it becomes operational and eventually the older OH-58 will be finally phased out.

Initial operating capability (IOC) for the U.S Army's Comanche is set for 2006. While the Comanche has its critics in the Senate and Pentagon, in the Army there is no doubt that the RAH-66 will be an indispensable asset in the early 21st century battlefield.

Specifications - RAH-66 Comanche

Country Of Origin	USA
Type	Reconnaissance Attack Helicopter
Manufacturer	Boeing Sikorsky

Dimensions

Main Rotor Diameter	12m (39ft 0.48 in)
Overall Length	14.2m (46ft 9.36 in)
Height	3.5m (11ft 7 in)
Fuselage Width	2.8m (9ft 3 in)

Weight

Normal take-off	3,522 kg (7,765lbs.)
Maximum take-off	5,845 kg (12,880 lbs.)
Primary Mission	5,276 kg (11,632 lbs.)

Power Plant

Turboshafts	2 x T800-LHTEC-801 Turboshaft
Take-off Power	2 x 1562 shp (shaft horse power)
Fuel (internal)	302 U.S gallons
Fuel (external)	900 U.S gallons

Performance

Never Exceed Speed	200 kts (370 km/h)
Cruise Speed	165 kts (305 km/h)
Maximum Rate of Climb at sea level	260 m/min (850 ft/min)
Hover Turn Rate	80° per/sec
Maximum Sideways Speed	60 kts (112 km/h)
Range (internal fuel)	485 km
Range (ferry tanks)	2,335 km

Armament

- 20mm Three-barrel Gatling Gun
- Longbow Hellfire
- AIM-92 Stinger Missile
- Hydra 70 rocket

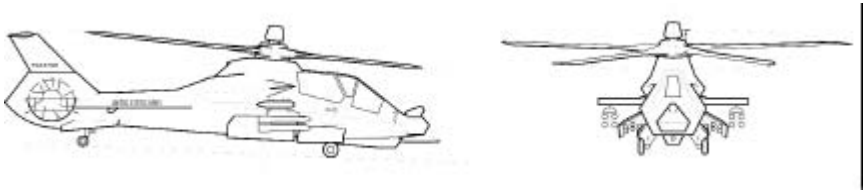
(NATO export options*)

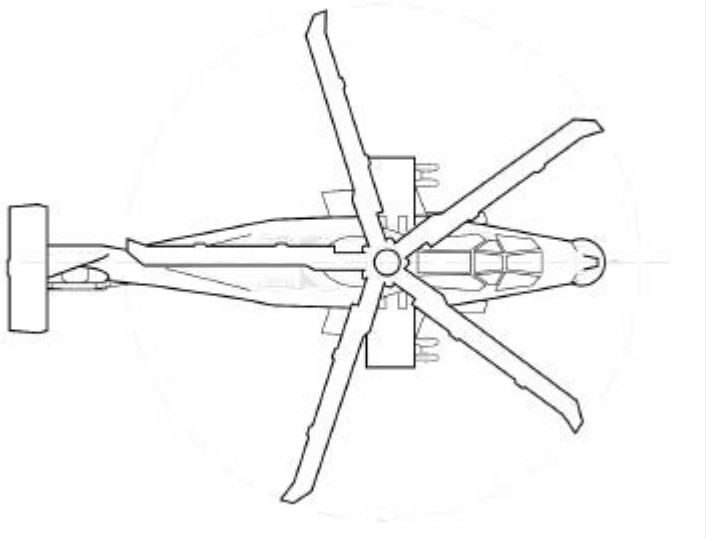
- Army Counter Air Weapon System
- TOW II Missile
- Starstreak
- Matra Mistral
- Euromissile HOT II
- Sura D-81mm Rocket
- Oerlikon Snora 81-mm Rocket

* Not featured in the simulation.

Features

- Five-bladed bearingless main rotor
- Fantail anti-torque system
- Triply redundant fly-by-wire control system
- Low-workload crew cockpit
- 4 x large flat panel color multifunction displays
- Wide field-of-view biocular helmet mounted display
- Low observable properties throughout
- Self-healing electronics
- Onboard electronic technical manual
- Simple plug-and-remove modular maintenance
- Internal missile bay
- Stowable three-barrel 20-mm Gattling gun





Ka-52 Hokum B "Alligator"

Created by the Kamov Design Bureau, the unusual co-axial rotor configuration has in some small way become one of the company's trademarks. Anti-armor helicopter design usually copies the Bell AH-1 Cobra configuration, tandem cockpit, single main rotor and anti-torque tail rotor.

Kamov's design approach is tempered by the view that the typical tail-rotor configuration imposes an unnecessarily high-degree of vulnerability to ground fire. Also the long transmission shaft and associated gearbox places high-loads on the tail boom, a structure vulnerable to ground strikes and contact damage when hovering in confined spaces.

Eliminating the anti-torque rotor and associated gearbox transmission is achieved by adopting a twin rotor configuration. One rotor is mounted above the other and spin in opposite directions thus cancelling the effect of torque. This system makes ground maintenance easier and more importantly to a pilot - increases helicopter performance, nearly all the power provided by the two turboshaft engines is delivered straight to the main rotor. There is no need to use power driving a tail rotor that doesn't provide any lift. Increased power allows for heavier armament more armor protection and greater speed – all of these are fundamental constraints when designing a battlefield helicopter.

The co-axial rotor configuration of the Ka-52 has other benefits; the helicopter is capable of performing flat-turns throughout the entire flight speed range. This affords an ability to rapidly turn the nose onto a target even at dash speeds or rapid sideways transitioning to

evade fire while attacking. Mechanics are battle-hardened, systems have been proved against rounds up to 23mm, the power-plant can run for 30 minutes without oil, this gives the pilot an opportunity to land in a safe location in the event the oil system is damaged.

The Alligator is a high-performance all-weather, day and night attack helicopter. The primary mission role being similar to the Comanche - battlefield reconnaissance and strike co-ordination. To achieve this, there is an impressive avionic and sensor fit.

First is the FH-01 Arbalat (Crossbow) centimetric and millimetric wavelength radar made by Phazotron. The centimetric antenna of the Crossbow has a 360-degree search capability and mounted in a small 2-foot diameter dome on top of the rotor mast. This provides the Ka-52's air search and track capability. The larger millimetric wave antenna mounted in the nose of the helicopter is used to detect ground objects (such as vehicles) and provide information for 3D terrain mapping avionics. Little is known about the search parameters of the Crossbow, estimates place it's ground search and track capability in excess of 11km.

The helicopters electro-optical package consists of a number of systems. Like the American AH-64 and RAH-66 combat helicopters, there are two discreet night vision sensors, one for the pilot and another for weapon sighting. A sensor ball positioned on the roof between the cockpit and the rotor mast houses the Samshit (Boxwood) STS gyro-stabilized reconnaissance & sighting unit. The Samshit incorporates a FLIR imager (PNVS), which feeds the pilots' helmet-mounted display. Located under the fuselage is a small hemispherical fairing which houses the weapon operators' periscope: its rotation and elevation is aligned with the Samshit pod. Laser designation and LLLTV (Low Light Level Television) weapon guidance is achieved using a standard Shkval-V turret; this flat windowed chin mounted housing is used for employing most of the Ka-52's beam riding weapons such as the supersonic Vikhr (Whirlwind). The accuracy of the target guidance system is so great, it is said you can choose which "wheel" to hit on targets as far as 8 to 10km away. Because of this accuracy the Vikhr can be used against air-to-ground or air-to-air targets, the missile adjusts its profile accordingly.

The "Glass Cockpit" is a new feature in Kamov helicopters, four French made multi-function color displays provide most of the instrumentation and systems management required for flight operations. An advanced EWS (Electronic Warfare Suite) provides early warning and countermeasures; basic components are the RWR (Radar Warning Receiver), Missile Warning System (MWS), Laser Warning Receiver (LWR) and chaff / flare launchers. The EWS displays threat information on a moving map display allowing the crew to relate threat bearing and distance to their immediate surroundings. Together with information from the radar and electro-optical sensors, this target data is automatically exchanged via a digital communications system to other force elements.

Navigation utilizes a combination of Inertial Guidance (laser gyroscopes and accelerometers) and GPS signals from both GLOSNASS and NAVSTAR satellites. This positional information is fed to an electronic moving map display that can be called up on one of the MFDs and also transmitted digitally to a ground command centre. Radio outfitting is made up of three VHF transceivers; one for monitoring the "guard" channel, one for secure communications and another for communicating with other mission specific force elements.

Gun installation consists of a 30mm 2A32 cannon mounted on a hydraulic drive that allows a limited amount of deflection: -2° to +9° azimuth (side to side) and +3° to -37° elevation (up and down). Cannon ammunition is supplied from two cartridge boxes, the fore box contains 240 rounds of armor piercing tracers, and the rear box contains 230 high-explosive incendiary rounds. The pilot selects which kind of ammunition to feed the gun and chooses between two rates of fire: high (550-600 rounds per minute) or low (350 rounds per minute). Burst lengths are automatically adjusted to either 10 or 20 rounds according to the rate of fire.

Kamov has gone to considerable lengths for crew protection. Just as with the Comanche, the crew cockpit is slightly pressurized to prevent NBC contamination. Protecting the crew from ground fire is approximately 300kg (661 lbs.) of steel hybrid armor in two layers. The steel armor is proved against direct hits by 20mm rounds. Lighter ceramic armor was rejected due to its tendency to shatter after successive impacts. In an emergency landing, the fuselage and landing gear struts can crumple to absorb large impact forces. Cockpit components and other structural elements are designed to preclude crew compartment volume compression by no more than 10-15%.

Another unusual feature of this helicopter is the "Pilot Rescue" capability by way of the K-37-800 ejection seat which was first fitted to the Ka-50 (the first helicopter in the world to be fitted with an ejector seat). Once the ejection handle has been pulled, a very carefully timed series of events take place. First, explosive charges in the rotor blade roots are detonated resulting in the separation of all 6 blades (this is potentially dangerous for any nearby onlookers). Both cockpit canopies are ejected sideways then the towing rocket on both ejection seats fire in low-thrust mode. When the towing-line is pulled taught the rocket increases thrust pulling the seat up on its mounting rails and out of the helicopter. After the rocket burn, the seat falls away and a cute is deployed. This ejection can be performed throughout the entire flight envelope including inverted flight (given a minimum altitude of 90 meters). Should a pilot eject over water, the seat is also fitted with survival pack and life raft. A survival beacon is activated automatically on ejection.

The Ka-52 is simple to control, highly maneuverable and has a lethal day/night weapons capability. A valuable asset for any modern army.

Development History

Since the mid-1970's, the mainstay of the soviet attack helicopter fleet was the Mi-24 Hind. This rather large and heavy helicopter, originally built as a flying Infantry Fighting Vehicle (IFV), has a capacity for ferrying up to 8 fully equipped soldiers. Over the years, it was realised that this troop carrying capability was underused; smaller lightweight (and more maneuverable) helicopters proved more suited to the anti-armor role. The USSR government took the decision to initiate the development of the next generation of army helicopters in December 1976. The task was handed to the Kamov Design Bureau and the Mil Helicopter Plant of Moscow.

In the early 1980's, Kamov demonstrated its light attack helicopter concept, it was designated V-80 (for "Helicopter of the 80s", V = "vertolyot" meaning helicopter). This helicopter was later re-designated the Ka-50 Hokum. In June 1982, the first Ka-50 prototype designated "White 010" made its maiden flight.

By 1990, soviet Army Aviation (Armeiskaya Aviatsiya) published its requirement for an anti-tank helicopter with night fighting capability. The Mil Helicopter Plant of Moscow submitted its two-seat Mi-28 Havoc and Kamov demonstrated their single-seat Ka-50 Hokum. Both officially won tender in 1994 and a year later, President Yeltsin signed a decree commissioning the Ka-50 for military service.

The first airframe left its Siberian factory in 1992. However lack of money forced production to stop after only 12 airframes had been built, and most of those did not meet the night flying requirement. As a result, Mil continued development of the Havoc, giving the company a chance to develop better night flying technologies and offer a more attractive helicopter.

With the difficulty in manufacturing heat vision equipment at that time, emphasis was placed on radar development. The Mi-28 and Ka-50 used the prototype Almaz and Arbalat (Crossbow) radar systems respectively. Advances in radar and FLIR design resulted in a much more complex avionic suite in both helicopters. This proved to be a great disadvantage in the single-seat Ka-50 where the pilot workload was considerably greater. Given the high weight of Soviet avionics, fitting a comprehensive suite of avionic systems to a two-seat helicopter was deemed impractical.

As it happens, a two-seat version of the Ka-50 had been constructed, used for pilot training it featured a side-by-side cockpit configuration. By adding more powerful engines and reducing protective armor, a practical two-seat attack helicopter was demonstrated. Further to this, Kamov contracted western companies to supply lighter and user-friendlier avionic components.

The first Ka-52 prototype designated "White 061" was premiered at the "Bangalore Aero India" show in 1996. It was based on the 11th production Ka-50 with a rebuilt front-fuselage section. It is estimated the Ka-52 is around 80-85 percent identical to the basic Ka-50 helicopter airframe and main system components. The principal dimensions of both helicopters remain more or less the same. White 061 was flown for the first time on the 25th June 1997 at Kamov's flight test base in Lyubertsty.

Experience with the Mi-24 Hind in Afghanistan had convinced Kamov that better crew co-ordination could be achieved by crew members sitting next to each other. Although interestingly Mil was not so convinced, and neither was Turkey when it evaluated the Hokum in 1998. Consequently this marked the start of an unlikely east/west relationship; Kamov in collaboration with Israeli Aircraft Industries (IAI) began work on the Ka-50-2. This is an export variant of the Ka-50/52 but has options for a traditional tandem cockpit and a turreted 20mm cannon mounted under the belly. The IAI sensor fit includes a night targeting and laser range-finder/designator package compatible with a subset of western missile systems.

Kamov are currently offering Armeiskaya Aviatsiya a mixed package of Ka-52s with existing Ka-50s upgraded to an all weather/night attack capability. Together they will adopt roles of battlefield reconnaissance, target identification/distribution and hand-off in a similar fashion to the AH-64D Apache and AH-64D fitted with the Longbow radar/fire control system.

Specifications – Ka-52 Hokum B

Country Of Origin	Russia
Type	Reconnaissance Attack Helicopter
Manufacturer	Kamov Design Bureau

Dimensions

Main Rotor Diameter	14.5m (47ft 5 in)
Overall Length	13.5m (44ft 3 in)
Height	4.9m (16ft 2 in)
Fuselage Width	2.6m (8ft 7 in)

Weight

Normal take-off	10,400 kg (22,928 lbs.)
Maximum take-off	11,300 kg (24,910 lbs.)
Primary Mission	1,811 kg (4000 lbs.)

Power Plant

Turboshafts	2 x TV3-117VMA-SB3s Turboshaft
Take-off Power	2 x 2,500 shp (shaft horse power)
Fuel (internal)	3,271 lbs.
Fuel (external)	3,792 lbs.

Performance

Never Exceed Speed	350 km/h (189 kts)
Cruise Speed	310 km/h (167 kts)
Hover Ceiling (out of ground effect)	5,500m (18,050 ft)
Maximum Rate of Climb at sea level	480 m/min (1,575 fpm)
Hover Turn Rate	80° per/sec
Range (internal fuel)	460 km
Range (ferry tanks)	1,200 km

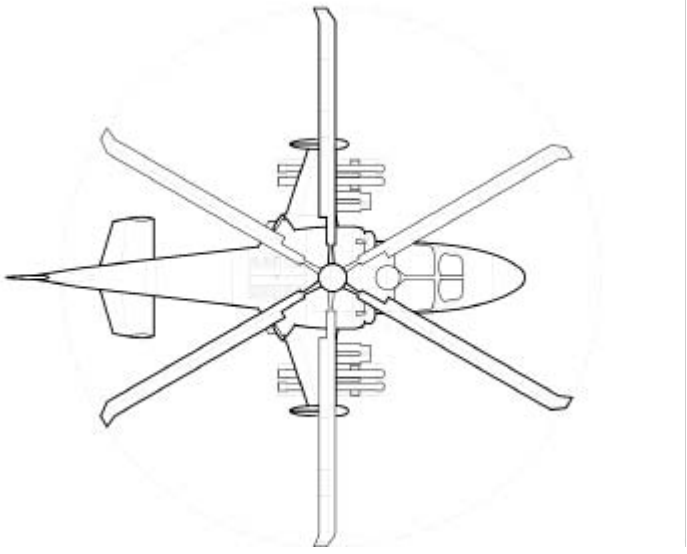
Armament

- 2A42 30mm cannon*
- S-8 80mm Rocket*
- S-13 122mm Rocket*
- Vikhr-M (AT-9) Laser Guided air-to-surface *
- Igla-V air-to-air missile*
- Kh-25ML (AS-12 Kegler) Laser Guided air-to-surface
- Kh-25MP anti-radar missile
- R-73 (AA-11 Archer) air-to-air missile
- KMGU-2 submunitions dispenser
- UPK-23 Gun Pod Twin 23mm*
- 500-kg aerial bomb
- 250-kg aerial bomb

* Featured in the simulation.

Features

- Co-axial rotor configuration
- Zvezda K-37-800 pilot ejection system
- Phazotron FH-01 Arbalat (Crossbow) CMW/MMW radar
- Shkval-V gyro-stabilized recon unit with TV, FLIR and Laser
- Under hull turret-mounted periscope
- Target data exchange over digital communications
- Automatic flight-control system
- Glass cockpit with Multi-Function Color Displays
- Hands On Collective And Stick (HOCAS)
- Helmet Mounted Display
- High power-to-weight ratio
- Reduced Pilot Workload



Performance Comparison Table

	RAH-66 Comanche	Ka-52 Hokum B
Never Exceed Speed	200 kts.	188 kts.
Max Forward Speed	172 kts (318 km/h)	161 kts (298 km/h)
Max Sideways Speed	60 kts	43 kts
Rate Of Climb (at sea level)	260 m/min (850 ft/min)	1,574 ft/min
Range (internal)	485 lm	450 km
Range (ferry)	2,335 km	1,200 km
Engine Output	2 x 1,563 shp	2 x 2,500 shp
Weight Max	5,845 kg	10,800 kg

Used Acronyms

AFAPD	Air-Force Applications Program Development
AFTDS	Advanced Field Artillery Tactical Data System
CMW	Centimetric Wave
EO	Electro Optics
EWS	Electronic Warfare Suite
FLIR	Forward Looking Infra Red
HF	High Frequency
HIDSS	Helmet Integrated Display & Sight System
HOCAS	Hands On Collective and Stick
IDM	Improved Data Modem
IOC	Initial Operating Capability
I-RAMS	Integrated Retractable Munitions System
LLLTV	Low Light Level Television
LO	Low Observable
MMW	Millimeter Wave
MTS	Marine Tactical Systems
NBC	Nuclear Biological Chemical
PNVS	Pilot Night Vision System
RCS	Radar Cross Section
TACFIRE	TACtical FIRE direction system
VMF	Variable Message Format

CAMPAIGN SCENARIOS

Sword In The Sand

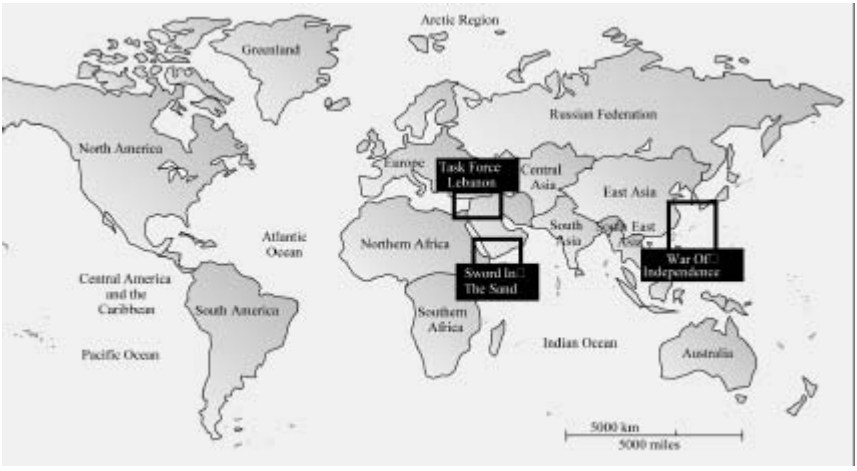
For ten years both Saudi Arabia and Yemen have been squabbling over the exact course of their mutual border, resulting in frequent armed clashes. As both sides re-arm with state of the art equipment from their respective super power patrons the discovery of rich oil deposits in the disputed region escalates the tension. Finally, another confrontation on the border triggers one or both sides to lose patience and the desert reverberates to the sound of helicopter engines as battle is joined over a 'line in the sand'.

War Of Independence

Beijing has always considered Taiwan to be part of China and talks between the two to resolve this have continually broken down. For the Chinese the final straw was the surprising victory of the Taiwan Independence Party (TIP) in the 2001 elections. The PLA, having spent the last decade re-equipping with state of the art Russian equipment, sees a window of opportunity to settle the issue by force of arms and under cover of large scale naval maneuvers launch a sudden invasion and rapidly seize the northern side of the island. With the UN Security Council prevented from taking action by the Russian veto the Americans rush a task force to the area determined to prevent the Chinese from consolidating their bridgehead.

Task Force Lebanon

The discovery of a plot by terrorists to detonate a nuclear warhead in Baltimore has made the US determined to renew the war against terrorism. The perpetrators are discovered to be sheltering in Lebanon and elements of the US 6th Fleet are dispatched to the area. The Lebanese militias, backed up with Russian hardware supplied through Syria, are determined to defend their homeland from American incursions and a 'swift surgical strike' soon degenerates into a much wider conflict.



Sword In The Sand

BLUE FORCE

From the Middle East Gazette

Blue Force Briefing (Saudi Arabia)

It appears that the Yemeni claims to the oil rich Marib border area have finally pushed the Saudis too far. For years the Yemeni government has been provoking the Saudis over this sensitive issue, the final straw being their granting of drilling rights in the disputed region to various foreign oil companies (including several Russian concerns). This Russian connection must not be overlooked. For several years the Russians, chafing under American global dominance, have been re-establishing links with their old client states wherever possible. They have been supplying an ever increasing amount of support to Yemen, possibly to offset their loss of influence in the northern part of the Persian Gulf. It is rumored, that should the Yemeni government prevail in its claims along the Saudi border they will grant the Russians naval basing rights at Aden (finally giving them what they have long craved - a warm water port).

We must also not forget the Yemeni support given to Saddam Hussein during the invasion of Kuwait. That this made them the outcasts of the Arab world seems to have made them only more determined to pursue their claims on Saudi Arabian territory. They have recklessly increased expenditure on their armed forces, despite the fact that they have long been unable to meet the repayment schedules and some say there is almost an air of desperation about this military adventure.

Despite this, the start of the conflict seems to have been carefully orchestrated by the Yemeni government. First there was their open support of fundamentalists hostile to the Saudi regime. This was swiftly followed by the show trials in Aden where hundreds of dissidents were rounded up and made to testify to being part of some far fetched Saudi plot. Then there was the government statement that Yemeni actions would be seen as ‘the signal

of a pan Arab awakening embodying the dreams of the Arab masses in a borderless great Arab homeland, a unified nation' (a statement chillingly similar to the one issued by Hussein during his attempt to annex Kuwait) and finally there was the granting of the drilling rights in the disputed border region.

The conflict appears to have erupted around several almost insignificant border villages - including Ifrine and Al - Baqah, the clashes occurring during Saudi military maneuvers. All Saudi attempts at reconciliation have been rebuffed and now the conflict can only be settled on the battlefield. Saudi units are already moving up to the border to put an end to these provocations once and for all.

RED FORCE

Partial transcript of a government broadcast to the Yemeni people

Red Force Briefing (Yemen)

Fellow Yemenis! Since 1969 Saudi Arabia has clung to the territory she illegally took from us despite all our attempts to settle the matter peacefully. We are a new nation, born out of the destruction of a dreadful civil war, anxious to be granted the hand of friendship. Instead we have discovered only selfish enmity. Surely you would think that a poor country such as ours would be allowed to share the mineral riches of the Marib in order that we could rebuild our shattered cities and give some measure of comfort to our people. But no! Our rich Saudi neighbors would not concede in this matter, despite the justness of our cause. Not content with merely attempting to drive us into poverty they have continually meddled in our affairs. They have sheltered the traitors who plunged us first into civil war. They insulted our noble leader, calling him an 'ignoramus' and 'parasitical and ignorant'.

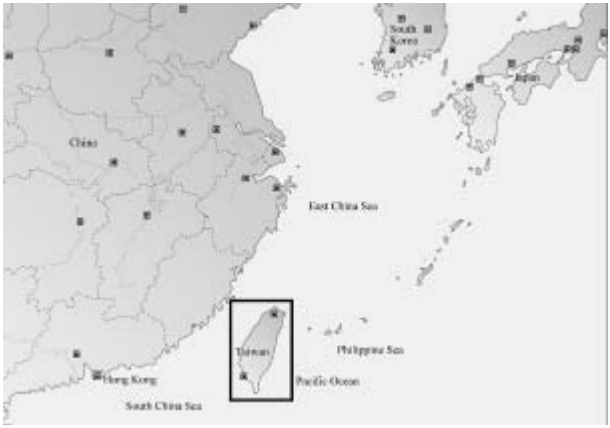
But they do not only use words to attack us. They have steadily built up the size of their army, despite the strain this so evidently places in their economy. When asked why they claimed that it was for protection against Iraq. But if this is so, why was it necessary to hold TEN days of live fire exercises along our border. Their plan became obvious when a plot was discovered to place bombs throughout our country. Thankfully the ringleaders were arrested before they could act and during their trial the truth emerged - that this vile conspiracy was organized by our neighbor.

No doubt smarting at their failure the Saudi units on this so called exercise have crossed the border and occupied the villages at Ifrine and Al - Baqah. It is now obvious that they resolutely oppose any peaceful solution to the border question, and with a heavy heart we have ordered our military units to defend our sovereign territory.

Our forces may be small, but it was they that unified our nation and they are still fiercely proud of this great endeavor. Even now our soldiers are preparing to valiantly defend Yemeni citizens so ruthlessly attacked by our implacable neighbors. Rest assured that they will strike, and strike hard at our foes to avenge all the slights and humiliations heaped upon us.

The struggle may be hard, the sacrifices many but we have come too far to be defeated now. Our cause is just and our victory will be absolute!

War Of Independence



BLUE FORCE

From a briefing given to a US aviation unit

Blue Force Briefing (Taiwan/USA)

Gentlemen. You are going to war. You are going to war in fulfilment of a promise. The promise that we gave to Taiwan that the 'United States make available to Taiwan such defense articles and defense services in such quantity as may be necessary to enable Taiwan to maintain a sufficient self defense capability'.

Sadly, the articles provided have failed to deter Chinese aggression, now it is up to you to ensure that we do not let the Taiwanese down. The first invasion echelon of the Chinese Army (PLA) has already formed a bridgehead on the northern part of the island under the cover of a considerable air umbrella. The second wave can be expected to land shortly and exploit the initial gains. Taiwanese forces, although putting up a brave resistance are being overwhelmed, both by numbers and technology. The situation is now critical. Be aware, there is nothing subtle about the Chinese operation. They have massed their best units in the area, and ensured that these are equipped with the most modern weapons they can lay their hands on. It will come as no surprise to you to learn that most of this has been provided by our old friends the Russians.

Our task force will shortly be entering the combat area and active operations will commence immediately. Your initial objective is to attack the Chinese bridgehead. It is imperative that not only is this contained and prevented from consolidating but that the follow on and support forces are also interdicted and attrited before they reach the main theater. It is essential that the enemy build-up is hampered to allow time for our reinforcements to reach the area. Until then gentlemen you will be on your own. With the situation stabilized we can carefully prepare our own riposte and so restore all of the island to its rightful owners.

Brief your men, prepare your aircraft and … give em hell!

territory yet its leaders have antagonized and insulted us. This perhaps could be borne with stoicism, for we always said that eventually there would be a peaceful rapprochement

RED FORCE

From a Chinese briefing to their armed forces

Red Force Briefing (China)

The situation with Taiwan has become intolerable. This after all is Chinese sovereign territory yet its leaders have antagonized and insulted us. This perhaps could be borne with stoicism, for we always said that eventually there would be a peaceful rapprochement between us. However, now the situation threatens to spiral out of control and our patience is exhausted. Unlike the restoration of Hong Kong and Macao a peaceful solution now seems impossible to come by.

The new government of Taiwan, the so called 'Taiwanese Independence Party' has stated quite unequivocally that they well be claiming independence from China. Such an adventurist action removes any claim to legitimacy that this so called government might have and we have resolved to undertake an action to remove them from power, finally ending these splittest tendencies.

Rest assured that you will be embarking on this action with the full support of the Chinese people behind you as this misguided island is restored to the protection of Beijing.

Do not undertake your duties lightly. Whilst there will be some resistance from the reactionaries in Taiwan, we feel the challenge you must meet and overcome will come from further afield. America has made no secret of its support for Taiwan and the opposition from this quarter will have to be overcome before final victory is assured.

You are well equipped for the task at hand. We have left no stone unturned to obtain for you some of the most modern weapons in the world. These have not only been produced in our new advanced factories and shipyards but have been bought from far and wide. Many have been provided by our friends the Russians. With ships, aircraft and missiles of the most advanced types our comrades in the navy and airforce have pledged to deliver you safely on Taiwan. It is then that your work will commence.

Equipment however can only do so much. It is upon your endeavors that the final decision will rest. You must look to the example of your leaders and cadre as you march to obtain the ultimate victory all our citizens so desperately crave.

Task Force Lebanon

BLUE FORCE

From a satellite news channel report

Blue Force Briefing (USA)

Who would have thought that a routine raid on a warehouse in Baltimore a few weeks ago would culminate in an American Task Force standing off the coast of Lebanon? Although it was a surprise to everyone when the FBI uncovered what turned out to be the equipment for the manufacture of a nuclear weapon all parts of the American intelligence establishment rapidly swung into action. The CIA traced the origin of the warheads plutonium to the Russian Tomsk-7 site whose security has been worrying experts for years. It appears that this material was smuggled out of Russia by the Mafia and into Turkey and from here down into Lebanon. This was where it fell into the hands of the terrorist splinter group 'The Sword of Freedom' which is reported to be based in the country. As soon as this was verified, large elements of the 6th Fleet set sail for the eastern Mediterranean whilst a retaliatory action was planned.

Unfortunately the situation today seems somewhat confused and the chance of a swift, surgical strike is rapidly diminishing. The Lebanese Militias have declared that American forces have no business in their waters and have been rapidly mobilizing their forces. It has now become apparent that Syrian support for these militias has been far more extensive than was first thought. The Militias have revealed themselves to be in possession of top of the range military hardware, most of which the Russians originally supplied to the Syrian army. The crisis has caused the various factions to unify in the face of what they see as little more than an American invasion and have pledged to resist any and all US incursions into their territory. They have made no secret of the fact that they believe they have the weapons to halt any US action dead in its track. Tensions have been raised to such a pitch that we now find ourselves in a 'hair trigger' situation and full scale military operations could commence at any minute.

A spokesman for the Task Force Admiral told me that 'whilst we have no wish to become embroiled in a shooting match with the Militias we are worried by the very real possibility that there may well be more of these weapons of mass destruction - or the material for their construction somewhere in the Lebanon. It is imperative that our forces are allowed to investigate this matter and punish those responsible. Whilst we seek the support of the Lebanese people in this affair, we cannot, and will not, allow ourselves to be deterred by their hostility'.

RED FORCE

From a Syrian government press release to assembled journalists

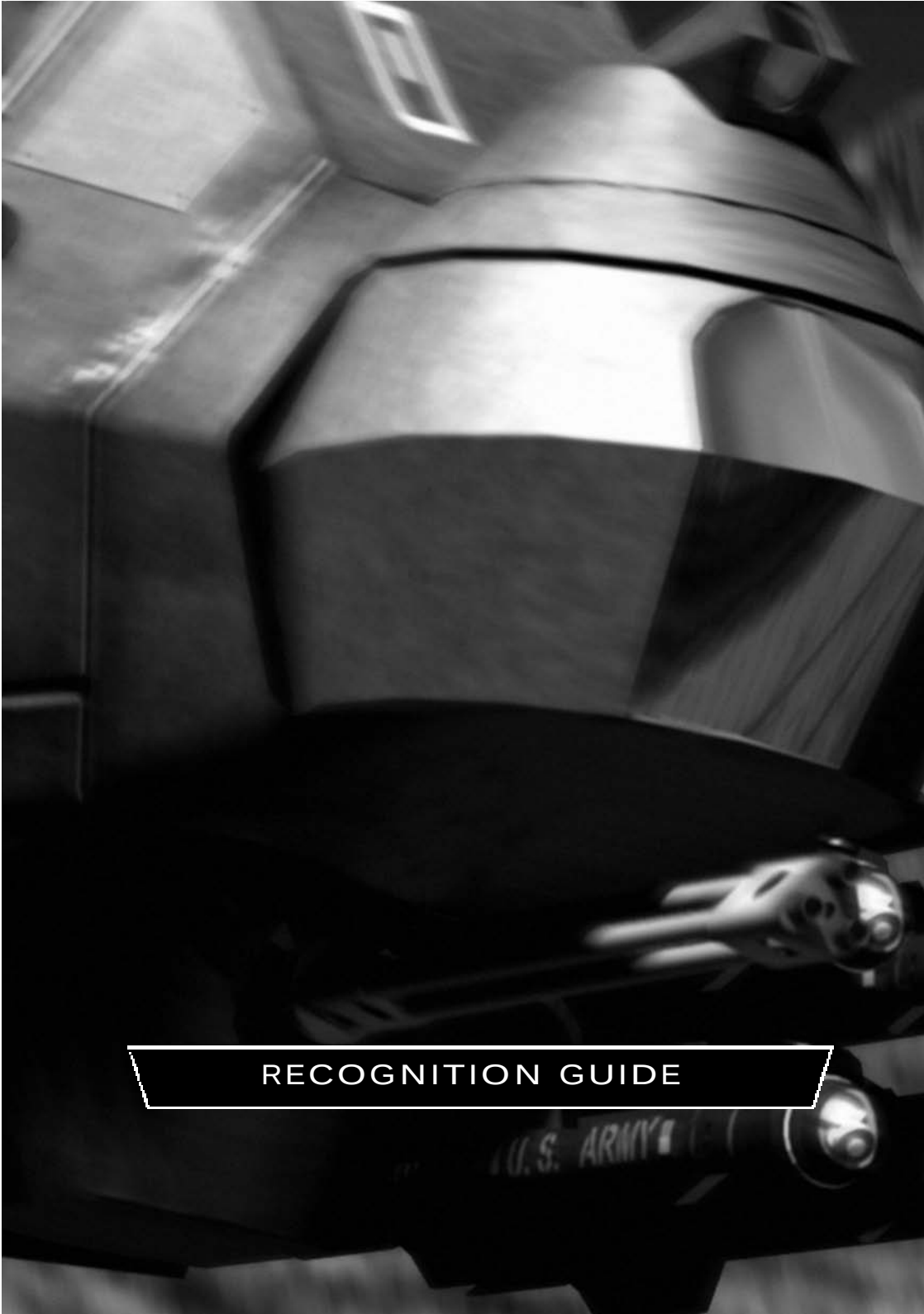
Red Force Briefing (Lebanese Militias/Syria)

In the first place we want to make it absolutely clear that Syria does not support or sponsor terrorist activities in any way. We do not do this now and will not do so in the future. We vehemently deny the irresponsible accusations concerning Syrian involvement with this so called 'Sword of Freedom' group. Indeed, we go further. We are not at all convinced that such a group exists, or if it does, that it is based in Lebanon. As you all know we have taken an active role in the rebuilding of that unhappy country and under our guidance and with our support it is now returning to a normal way of life. Should all of this be jeopardized on the say so of the American CIA? Has not this much vaunted organization been wrong in the past?

As we have said, we have no interest in terrorism and offer no succor to its perpetrators. However, in the face of what can only be seen as an irresponsible and reckless American adventure we absolutely maintain the right of the Lebanese people to actively defend themselves with every means at their disposal. Over the years too many foreigners have meddled in Lebanese affairs with no call to do so and this threatened American action is no different. Finally with our support, and the assistance of our friends in Russia our colleagues in Beirut have the weapons to protect themselves and we very much hope that this will deter the Americans from their reckless and dangerous endeavor.

Should this deterrence fail be aware that Syria does not, and will not abandon its friends and allies. We are fully prepared to furnish every assistance to the Lebanese in the face of this gross American provocation.

Once more, we say again that every nation has the right to self defense and to resist outside meddling in their internal affairs. America should be aware that Syria will ensure that the Lebanese have, and will continue to have, the means with which to uphold this right.



RECOGNITION GUIDE

USA COMBAT HELICOPTERS

Type: Attack

AH-64A Apache

Recognition features:

- 4-bladed main rotor - no radome - and 4-bladed X-shaped tail rotor
- tandem cockpit arrangement under single flat-glazed canopy
- stub wings with wingtip missile mounts
- engine nacelles on each side of fuselage with 'fish tail' exhaust cooling vanes to rear
- slender symmetrical sponsons on each side of cockpit blending under fuselage nose section
- nose-mounted TADS / PNVS turrets
- chain gun turret-mounted under forward fuselage
- all moving tail plane
- fixed main undercarriage and tail wheel

Armament:

- M230 30mm Chain Gun
- AIM-92 Stinger IR guided air-to-air missiles
- AGM-114K Hellfire II laser guided anti-tank missiles
- Hydra 70 M255 unguided rockets (HE)
- Hydra 70 M261 unguided rockets (MPSM)

Decoys:

- chaff
- flares

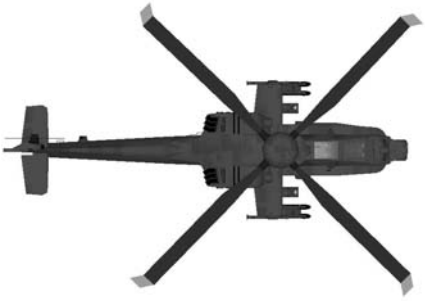
Game notes:

- radar symbol: 
- ground radar priority: medium

USA COMBAT HELICOPTERS

Type: Attack

AH-64D Apache Longbow



Recognition features:

- 4-bladed rotor with 'Swiss cheese' style radome, 4-bladed 'X' shaped tail rotor
- tandem cockpits with single canopy
- stub wings with wing-tip missile mounts
- engine nacelles on each side of fuselage with 'fish-tail' exhaust cooling vanes to rear
- enlarged flat-sided sponsons (avionics bays)
- nose-mounted TADS/PNVS turrets
- chain gun turret mounted under forward fuselage
- all-moving tail-plane
- fixed undercarriage and tail wheel

Armament:

- M230 30mm Chain Gun
- AIM-92 Stinger IR guided air-to-air missiles
- AGM-114L Longbow Hellfire radar guided anti-tank missiles
- AGM-114K Hellfire II laser guided anti-tank missiles
- Hydra 70 M255 unguided rockets (HE)
- Hydra 70 M261 unguided rockets (MPSM)

Decoys:

- chaff
- flares

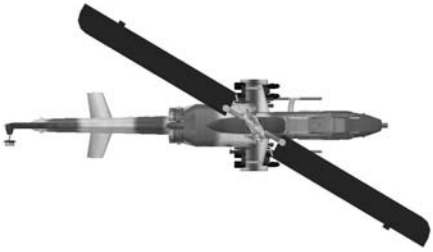
USA COMBAT HELICOPTERS

Type: Attack

AH-1W SuperCobra

Recognition features:

- broad twin rotor blades
- tall narrow fuselage, short ridged tail boom with centrally mounted tail plane, sharply backward slanting tail fin
- narrow tandem cockpit arrangement under single rounded canopy, shallow sponsons each side of forward fuselage section
- rounded air intakes and engine nacelles each side of fuselage separated by raised ridge at rear, distinctive twin elongated oval exhaust outlets
- sharply pointed nose with conical TADS turret under
- short stub wings with wing tip weapons pylons and edge-on ECM pods on upper wing surface
- chin-mounted triple-barrelled nose gun turret
- squat landing skids under central section



Armament:

- 20mm cannon
- AIM-92 Stinger IR guided air-to-air missiles
- AGM-114K Hellfire II laser guided anti-tank missiles

Decoys:

- chaff
- flares

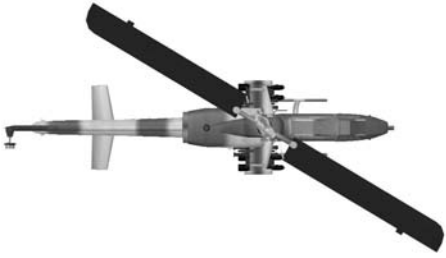
Game notes:

- radar symbol: ⋈
- ground radar priority: medium

USA COMBAT HELICOPTERS

Type: Marine attack

AH-1T SeaCobra



Recognition features:

- broad twin rotor blades
- tall narrow fuselage, short ridged tail boom with centrally mounted tail plane, sharply backward slanting tail fin
- narrow tandem cockpit arrangement under single rounded canopy
- elongated air intakes to rounded engine nacelles each side of fuselage joining in flat ended projection at rear with twin circular exhaust outlets
- sharply pointed nose with conical TADS turret under
- short stub wings with wing tip weapons pylons and edge-on ECM pods on upper wing surface
- chin-mounted gun turret with long triple-barrelled cannon
- squat landing skids under central section

Armament:

- 20mm cannon
- AIM-92 Stinger IR guided air-to-air missiles
- AGM-114K Hellfire II laser guided anti-tank missiles

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: medium

USA COMBAT HELICOPTERS

Type: Reconnaissance/attack

RAH-66 Comanche

Recognition features:

- 5-bladed 'low profile' main rotor with enclosed hub and mast-mounted conical radome, integral fenestron tail rotor
- distinctive angular stealth composite fuselage design with asymmetrical canted tail section and canted T-shaped tail configuration
- tandem cockpit arrangement under single high visibility flush sided canopy
- shallow angular engine nacelles with distinctive triangular inlets
- conical nose-mounted TADS/PNVS turret
- retractable weapons bay doors with integral pylons, optional detachable stub wings to provide additional weapons hardpoints
- chin-mounted stowable cannon turret
- retractable main undercarriage and tail wheel

Armament:

- 20mm Gatling gun
- AIM-92 Stinger IR guided air-to-air missiles
- AGM-114L Longbow Hellfire radar guided anti-tank missiles
- AGM-114K Hellfire II laser guided anti-tank missiles
- Hydra 70 M255 unguided rockets (HE)
- Hydra 70 M261 unguided rockets (MPSM)

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: medium
- stealth features reduce radar signature

USA COMBAT HELICOPTERS

Type: Scout

OH-58D Kiowa Warrior

Recognition features:

- 4-bladed main rotor with large mast-mounted spherical sight, twin-bladed tail rotor
- tall and narrow curved fuselage, flat sided engine compartment atop with large ECM mount to rear
- small sharply rounded nose section with bubble glazed cockpit giving distinctive 'bug-eyed' appearance
- slender round-section tail boom with centrally located tailplane and twin fins to rear,
- squat landing skids under central section
- upward cranked tubular external stores supports for weapons payloads

Armament:

- AIM-92 Stinger IR guided air-to-air missiles
- AGM-114K Hellfire II laser guided anti-tank missiles

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: medium

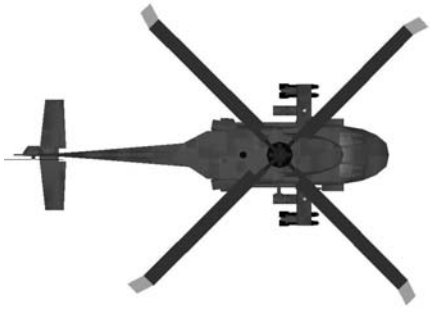
USA COMBAT HELICOPTERS

Type: Attack/assault

UH-60 Black Hawk

Recognition features:

- 4-bladed main rotor and 4-bladed tail rotor
- twin seat side-by-side cockpit
- low and wide appearance to main fuselage section with flat underside and elongated nose
- sliding doors on either side of main cabin
- IR suppressors fitted to engine exhaust outlets
- external stores supports for weapon pylons
- all-moving tail-plane
- fixed undercarriage and tail wheel



Armament:

- AGM-114C Hellfire radar guided anti-tank missiles
- Hydra 70 M255 unguided rockets (MPSM)

Decoys:

- chaff
- flares

Game notes:

- radar symbol: 
- ground radar priority: medium

USA COMBAT HELICOPTERS

Type: Marine assault

CH-46E Sea Knight

Recognition features:

- twin 3-bladed tandem main rotors
- twin seat side-by-side cockpit inside glazed nose
- long rectangular fuselage with elevated engine housings and rearward stub wings
- rear hinged loading ramp to cargo hold
- fixed tricycle undercarriage with main rear wheels supported by stub wings

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: medium

USA TRANSPORT HELICOPTERS

Type: Medium-lift

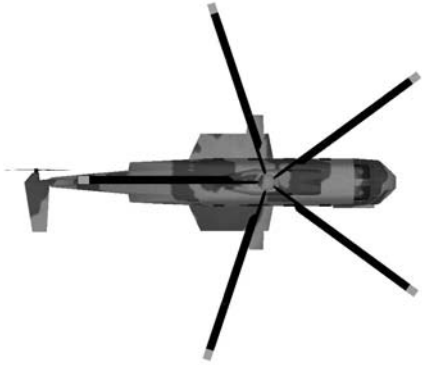
CH-3
(Jolly Green Giant)

Recognition features:

- 5-bladed main rotor and 5-bladed tail rotor
- twin seat side-by-side cockpit behind shallow nose
- long main fuselage with sloping rear section and short tail boom
- rear hinged loading ramp to cargo hold
- semi-retractable tricycle undercarriage with main rear wheel housings in stub wings

Decoys:

- chaff
- flares



Game notes:

- radar symbol: ⋈
- ground radar priority: medium

USA TRANSPORT HELICOPTERS

Type: Heavy-lift

CH-47D Chinook

Recognition features:

- twin 3-bladed tandem main rotors
- twin seat side-by-side cockpit inside glazed nose
- long rectangular fuselage (bulging along lower sides), elevated front and rear engine housings
- external engine nacelles on rear sides of fuselage
- rear hinged loading ramp to cargo hold
- fixed 4-wheeled undercarriage

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: medium

USA TRANSPORT HELICOPTERS

Type: Medium-lift tilt-rotor

MV-22 Osprey

Recognition features:

- distinctive twin 3-bladed tilt-rotors and rounded hub spinners
- high-wing configuration with short wing sections supporting large tilt rotor engine nacelles at tips
- rounded square-section flat bottomed fuselage, with large bulging underwing sponsons
- short rounded nose section, side-by-side cockpit arrangement under single rounded canopy, nose-mounted mini radome and forward projecting refuelling probe
- rear sloping fuselage section rising to distinctive flattened and curved rear tail boom supporting twin finned tail plane with hinged loading ramp to cargo hold under
- squat retractable tricycle undercarriage

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: medium

USA TRANSPORT HELICOPTERS

Type: Heavy-lift

CH-53E Super Stallion

Recognition features:

- large 7-bladed main rotor with flattened circular hub cap, canted 4-bladed tail rotor
- broad and long rounded square sectioned fuselage sloping up to short tail boom with flattened underside, sharply canted tail fin with distinctive cranked side-mounted tail plane
- rounded engine housing tapering along upper fuselage, large outboard tubular air intakes with conical intake filters, large angled circular exhaust tubes to rear
- large curved sponsons at centre section with projecting outer supports for large droptanks
- distinctive rounded flat nose section incorporating cockpit nose glazing and forward projecting refuelling probe
- rear hinged loading ramp to cargo hold
- squat semi-retracting tricycle undercarriage

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: medium

USA COMBAT AIRCRAFT

Type: Close air support

A-10A Thunderbolt

Recognition features:

- low-wing, square leading and trailing edge with upward canted outer sections and down-turned wing-tips, projecting fairings over main landing gear
- short nose with 'up-front' cockpit arrangement
- twin fin assembly
- large pair of circular engine nacelles mounted on upper rear fuselage
- many under-wing weapon hard points and large nose mounted cannon
- semi-retractable tricycle undercarriage

Armament:

- 30mm cannon
- AIM-9M Sidewinder IR guided air-to-air missiles
- LAU-69/A unguided rockets

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: medium

USA COMBAT AIRCRAFT

Type: Multi-role fighter

F-16 Fighting Falcon

Recognition features:

- mid-wing, swept leading edge, square trailing edge, wings blended to fuselage
- long bubble-shaped canopy and short sharp nose
- single large curved air intake under nose
- single large tail fin, downward canted all-moving tail plane
- wing-tip missile mounts, under-wing hard-points
- retractable tricycle undercarriage

Armament:

- 20mm cannon
- AIM-9M Sidewinder IR guided air-to-air missiles
- AIM-120 AMRAAM radar guided air-to-air missiles
- AGM-65D Maverick IR guided air-to-surface missiles

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: medium

USA COMBAT AIRCRAFT

Type: Carrier-borne attack

AV-8B Harrier

Recognition features:

- high-wing, swept leading and trailing edges, sharp downward cant
- swept tail fin, downward canted all-moving tail plane
- compact bulbous fuselage with rounded main air intakes immediately aft of either side of cockpit
- short nose with 'up-front' cockpit arrangement
- thrust vectoring nozzles under wings on either side of fuselage
- under-wing hard-points, under-fuselage bulging cannon housing
- retractable main landing gear with under-wing retractable stabilisers

Armament:

- 25mm cannon
- AIM-9M Sidewinder IR guided air-to-air missiles
- LAU-69/A unguided rockets

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: medium

USA COMBAT AIRCRAFT

Type: Carrier-borne interceptor

F/A-18 Hornet

Recognition features:

- mid-wing, swept leading edge extended into 'hood' along forward fuselage, square trailing edge
- long slender nose section and canopy, with wings centered well aft of fuselage center line
- swept all-moving tail plane well aft of tall sharply canted twin tail fins
- engine intakes either side of fuselage under wing leading edge, closely-spaced rear nozzles
- under-wing and fuselage hard-points with wing-tip missile mounts
- retractable tricycle undercarriage

Armament:

- 20mm cannon
- AIM-9M Sidewinder IR guided air-to-air missiles
- AIM-120 AMRAAM radar guided air-to-air missiles
- AGM-65F Maverick IR guided air-to-surface missiles

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: medium

USA TRANSPORT AIRCRAFT

Type: Medium-lift

C-130J Hercules II

Recognition features:

- 4 propfan engines on under-wing engine nacelles, distinctive sabre-like 6-bladed propellers
- broad high-wing configuration with square leading edge blending to fuselage
- distinctive broad tail plane and tall round-topped tail fin arrangement
- large circular-sectioned fuselage rising to broadly flattened and tapered tail boom at rear, rounded bulging sponsons to lower underwing section
- short rounded up-turned nose below broad rounded cockpit section with distinctive wrap-around glazing
- large hinged cargo doors to rear under sloping tail underside
- retractable undercarriage with 4 fixed main wheels and twin steerable nose wheels
- no under-wing fuel tanks as per earlier Hercules variants

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: medium

USA TRANSPORT AIRCRAFT

Type: Heavy-lift

C-17 Globemaster III

Recognition features:

- 4 stout turbo-fan engines mounted on large forward-projecting under-wing pylons with large circular metallic air intakes and conical exhaust outlets to rear
- distinctive swept high-wing configuration, large downward sloping tapered wings ending in up-turned swept winglets, large underwing deflection flaps and rearward projecting supporting fins
- huge circular-section main fuselage, bulging over wing junction, rear raised bulging tail section tapering to rounded point at rear, flattened underside at hinged cargo door area
- large underwing sponsons, smoothly blended to mid fuselage and angling outwards at base, rounding back into fuselage underbelly
- large distinctive swept T-tail configuration
- smoothly rounded tapering nose section with wrap-around glazed cockpit
- retractable undercarriage with 12 fixed main wheels arranged in 4 triplets at rear and twin steerable nose wheels

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: medium

USA ARMORED VEHICLES

Type: Main battle tank

M1A2 Abrams

Recognition features:

- tracked - 7 road wheels plus drive sprocket and idler on either side
- long low flat-sided hull, flat raised rear section behind turret, flattened rear end with engine louvres and circular lamp housings
- large angular low profile turret topped by small thermal sighting turret and large hatch-mounted MG with stowage racks to rear
- long high calibre main gun barrel overhangs hull front

Armament:

- 120mm gun
- 12.7mm machine gun

Decoys:

- smoke grenades

Game notes:

- radar symbol: 
- ground radar priority: medium
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armored
- night vision equipment

Type: Infantry fighting vehicle

M2A2 Bradley

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on either side
- angular high-sided hull, sloping front and port-side inset driver's hatch, flattened rear end with troop compartment loading ramp and large projecting stowage bins on either side
- small angular turret with secondary armor panels to rear, short low caliber main gun barrel and side mounted flip-up TOW launcher

Armament:

- 25mm cannon
- M220 TOW2B tube-launched optically-tracked wire-guided missiles

Decoys:

- smoke grenades

Game notes:

- radar symbol: 
- ground radar priority: high
- surface-to-air ceiling 2,000m
- surface-to-air range 4,000m
- armored
- night vision equipment

USA ARMORED VEHICLES

Type: Armored personnel carrier

M113A2

Recognition features:

- tracked - 5 road wheels plus drive sprocket and idler on either side
- high-sided box-shaped hull, backward sloping front and flattened rear end with loading ramp to troop compartment
- hatch mounted MG on hull topside (no turret)

Armament:

- 12.7mm machine gun

Game notes:

- radar symbol: 
- ground radar priority: high
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armored
- night vision equipment

Type: Scout car

M1025 HMMWV (HumVee)

Recognition features:

- high 4-wheeled chassis
- distinctive flat-sided wide and low-profiled body, square front, slightly sloping bonnet, vertical windshield, downward slope at rear end of cab roof
- roof-mounted MG

Game notes:

- radar symbol: 
- ground radar priority: low

USA SELF-PROPELLED ARTILLERY

Type: Artillery (howitzer)

M109A2 (155mm)

Recognition features:

- tracked - 7 road wheels plus drive sprocket and idler on either side, no side-skirts over tracks
- wide angular hull with bevelled nose section and downward sloping top at front, flattened rear with hull access door and stowed entrenching 'spades'
- large flat-topped turret centered aft with sloping curved front and flat sides, thermal sighting turret and hatch-mounted MG atop, flattened rear end with projecting stowage box and racks
- very long high caliber main gun extending well forward of hull front with large open-sided muzzle

Armament:

- 155mm howitzer
- 12.7mm machine gun

Game notes:

- radar symbol: 
- ground radar priority: medium
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armored
- night vision equipment

Type: Multiple rocket systems

M270 MLRS (227mm)

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on either side, no side-skirts over tracks
- box-shaped cab section at front with backward sloping front-face and protective louvres over windows, rear flatbed platform for launcher
- large box-shaped turret-mounted multiple rocket launcher stowed horizontally at rear, turned and pitched to firing position

Armament:

- 227mm rockets

Game notes:

- radar symbol: 
- ground radar priority: low

USA AIR DEFENSE VEHICLES

Type: AAA

M163 Vulcan

Recognition features:

- tracked - 5 road wheels plus drive sprocket and idler on either side
- high-sided box-shaped hull, backward sloping front with bulged section, box-shaped bulges along upper sides, flattened rear end
- small circular turret with sloping sides and flat open top, small side-mounted radar dish, distinctive multi-barrelled cannon on pivoting 'skeleton' mount

Armament:

- 20mm cannon

Game notes:

- radar symbol: ▲
- ground radar priority: high
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armored
- night vision equipment
- range-only radar

Type: SAM

M1037 Avenger

Recognition features:

- high 4-wheeled chassis
- distinctive flat-sided wide and low-profiled body, square front, slightly sloping bonnet, vertical windshield to cut-short cab, flatbed launcher platform to rear
- platform-mounted box-shaped sloping-top turret with pivoting side-mounted rectangular rocket launchers

Armament:

- FIM-92A Stinger IR guided surface-to-air missiles

Game notes:

- radar symbol: ▲
- ground radar priority: high
- surface-to-air ceiling 3,000m
- surface-to-air range 5,000m
- night vision equipment

USA SELF-PROPELLED ARTILLERY

Type: SAM

M48A1 Chaparral

Recognition features:

- tracked - 5 road wheels plus drive sprocket and idler on either side
- box-section hull with sloping front, raised rectangular forward cab section and flatbed launcher platform to rear
- platform-mounted flat-sided curved roof turret on circular base with Chaparral missile pairs mounted on either side

Armament:

- Chaparral IR guided surface-to-air missiles

Game notes:

- radar symbol: ▲
- ground radar priority: high
- surface-to-air ceiling 3,000m
- surface-to-air range 5,000m
- night vision equipment
- FLIR

USA TRANSPORT VEHICLES

Type: Light 4x4 vehicle

M998 HMMWV (HumVee)

Recognition features:

- high 4-wheeled chassis
- distinctive flat-sided wide and low-profiled body, square front, slightly sloping bonnet, vertical windshield to cut-short cab, flatbed cargo area to rear

Game notes:

- radar symbol: ●
- ground radar priority: low

USA TRANSPORT VEHICLES

Type: Utility vehicle (truck)

M923A1 “Big Foot”

Recognition features:

- high 6-wheeled truck chassis - 2 wheels in front, 4 at rear
- large flat radiator grille with integral headlights, flat tapering bonnet, box-shaped cab with vertical windshield, angled mud guards over front wheels
- high sided canvas covered cargo area to rear

Game notes:

- radar symbol: ●
- ground radar priority: low

Type: Fuel tanker

M978 (HEMTT)

Recognition features:

- high 8-wheeled chassis - 2 pairs of 4 wheels
- distinctive forward-projecting cab with steeply angled large flat windshield and underside, narrow rectangular section behind cab with side-mounted spare wheel
- large curved-sided flat-topped fuel tank to rear and adjoining downward angled curved rear end section

Game notes:

- radar symbol: ●
- ground radar priority: low

USA WARSHIPS

Type: Amphibious assault ship

Tarawa Class

Recognition features:

- wide and high-sided box-section hull, long bow, square stern section
- continuous flight deck
- port side outboard aircraft lift, stern inboard aircraft lift, large stern water-line loading door
- long narrow rectangular starboard side superstructure, large forward-mounted lattice mast and aft-mounted structures atop
- two storey bridge
- large deck-side crane

Armament:

- 25mm cannons
- Sea Sparrow radar guided surface-to-air missiles

Game notes:

- radar symbol: ⧗
- ground radar priority: high
- surface-to-air ceiling 5,000m
- surface-to-air range 1,0000m
- air search radar

Type: Frigate

Oliver Hazard Perry Class

Recognition features:

- slender low-profile hull with sharp high-sided bow, square inward sloping shallow stern
- long high-sided box-section superstructure forward raised bridge section, small spherical radome atop
- tall central lattice mast with large outboard aerials, shorter forward mast with large rectangular radar dish atop
- small forward deck gun position on circular base
- aft deck-level helicopter landing pad

Armament:

- 76mm guns
- SM-1MR Standard radar guided surface-to-air missiles

Game notes:

- radar symbol: ⧗
- ground radar priority: high
- surface-to-air ceiling 5,000m
- surface-to-air range 10,000m
- air search radar

USA WARSHIPS

Type: Landing craft

Tarawa Landing Craft

Recognition features:

- flat rectangular hull with squarely angled-in bow and stern, raised gusseted sides to cargo deck
- hinged bow loading ramp, twin crane booms astern
- narrow box-shaped superstructure on starboard side cargo deck, single pole-mounted radar antenna

Game notes:

- radar symbol: ▼
- ground radar priority: low

Type: Hovercraft

LCAC

Recognition features:

- rectangular flat-bed hull, widely projecting all-round inflatable skirt with square corners
- long and narrow deck-side superstructures with top-mounted engine intakes/exhausts
- hinging bow and stern loading ramps
- prop-shafts to aft-mounted twin 5-bladed propellers in circular enclosures with rudder planes attached

Game notes:

- radar symbol: ▼
- ground radar priority: low

RUSSIAN COMBAT HELICOPTERS

Type: Attack

Mi-28N Havoc-B

Recognition features:

- 5-bladed main rotor with spherical radome, 4-bladed 'X' shaped tail rotor
- tandem 'stepped' separate cockpit arrangement
- nose-mounted radome with FLIR turret underneath
- rounded engine nacelles with downward pointing rearward exhaust outlets
- stub-wings (downward sloping) with pylons and wing-tip ECM pods
- chin-mounted cannon turret with ammo panniers
- asymmetrical tail plane arrangement
- fixed undercarriage and tail wheel

Armament:

- 30mm cannon (both armour piercing and high explosive rounds)
- Igla-V IR guided air-to-air missiles
- Ataka radio command guided anti-tank missiles
- 80mm unguided rockets
- 130mm unguided rockets
- GSh-23L 23mm cannon pods

Decoys:

- Chaff
- Flares

Game notes:

- radar symbol: ⋈
- ground radar priority: medium

RUSSIAN COMBAT HELICOPTERS

Type: Attack

Ka-50 Hokum

Recognition features:

- twin 3-bladed co-axial main rotors (no tail rotor), mast-mounted 'mini' radome
- single seat cockpit with angular flat armor glass canopy
- narrow angular cockpit section blending to smoothly sharpened nose section with chin-mounted fixed sight on flattened underside, rounded square-section tail boom with even taper to point at rear
- rounded engine nacelles each side of upper fuselage immediately aft of cockpit, domed dust filters to air intakes
- distinctive tail configuration - angular tail fin and tail plane with endplate fins
- enlarged stub wings with weapons pylons and wing tip ECM pods
- side-mounted 30mm cannon
- retractable tricycle undercarriage

Armament:

- 30mm cannon (both armor piercing and high explosive rounds)
- Igla-V IR guided air-to-air missiles
- Vikhr laser guided anti-tank missiles
- 80mm unguided rockets
- 130mm unguided rockets
- GSh-23L 23mm cannon pods

Decoys:

- chaff
- flares

Game notes:

- radar symbol: 
- ground radar priority: medium

RUSSIAN COMBAT HELICOPTERS

Type: Reconnaissance/attack

Ka-52 Hokum-B

Recognition features:

- twin 3-bladed co-axial main rotors (no tail rotor), mast-mounted 'mini' radome
- twin seat side-by side cockpit with flat armor windshield and curved 'gull-wing' style upward opening canopy doors
- smoothly sculpted forward fuselage section with rounded nose, rounded square-section tail boom with even taper to point at rear
- rounded engine nacelles each side of upper fuselage immediately aft of cockpit, domed dust filters to air intakes
- distinctive tail configuration - angular tail fin and tail plane with endplate fins
- nose-mounted cylindrical FLIR turret, spherical SAMSHIT turret above cockpit rear
- enlarged stub wings with weapons pylons and wing tip ECM pods
- side-mounted 30mm cannon
- retractable tricycle undercarriage

Armament:

- 30mm cannon (both armor piercing and high explosive rounds)
- Igla-V IR guided air-to-air missiles
- Vikhr laser guided anti-tank missiles
- 80mm unguided rockets
- 130mm unguided rockets
- GSh-23L 23mm cannon pods

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: medium

RUSSIAN COMBAT HELICOPTERS

Type: Attack/assault

Mi-24D Hind

Recognition features:

- 5-bladed main rotor, 3-bladed tail rotor
- tandem stepped cockpits with domed canopies
- tall and narrow appearance to main fuselage
- hinged loading doors on either side of main cabin
- IR suppressors fitted to engine exhaust outlets
- sharply downward angled stub wings with weapons pylons and down turned wing-tips
- chin-mounted gun-turret and sight/radar mounts
- retractable tricycle undercarriage

Armament:

- 12.7mm Gatling gun
- AT-6 Spiral radio command guided anti-tank missiles
- 57mm unguided rockets
- 80mm unguided rockets

Decoys:

- chaff
- flares

Game notes:

- radar symbol: 
- ground radar priority: medium

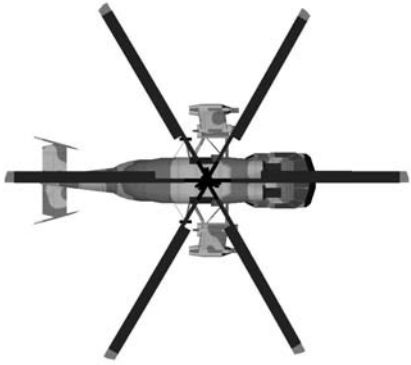
RUSSIAN COMBAT HELICOPTERS

Type: Marine assault

Ka-29 Helix-B

Recognition features:

- twin 3-bladed co-axial main rotors (no tail rotor)
- twin seat side-by-side cockpit
- short rectangular section fuselage with distinctive flat nose and tail plane with endplate fins
- hinged loading doors on either side of main cabin
- weapon pylons supported on outboard racks
- fixed 4-wheeled undercarriage with main gear outboard of fuselage sides



Armament:

- 57mm unguided rockets
- 80mm unguided rockets

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: medium

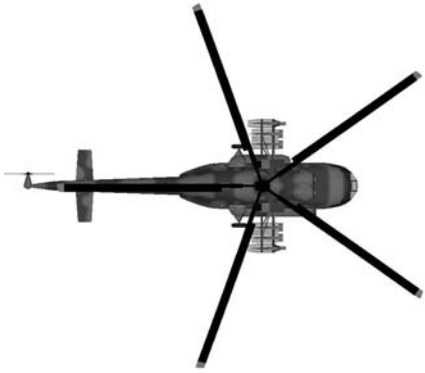
RUSSIAN TRANSPORT HELICOPTERS

Type: Medium-lift

Mi-17 Hip

Recognition features:

- 5-bladed main rotor and 3-bladed tail rotor
- twin seat side-by-side cockpit inside glazed nose
- long rounded main fuselage and slender tail boom
- rear fuselage has 'clam shell' cargo hold doors
- IR suppressor fitted to engine exhaust outlets
- weapon pylons supported on outboard racks
- fixed tricycle undercarriage with outboard struts supporting main wheels



Armament:

- 57mm unguided rockets
- 80mm unguided rockets

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: medium

RUSSIAN TRANSPORT HELICOPTERS

Type: Heavy-lift

Mi-6 Hook

Recognition features:

- 5-bladed main rotor and 4-bladed tail rotor
- twin seat side-by-side cockpit aft of glazed observers station in nose
- extremely long rounded main fuselage section with shorter tail boom
- large wings, tail plane and external fuel tanks
- rear fuselage has ‘clam shell’ cargo hold doors
- fixed tricycle undercarriage with outboard struts supporting main wheels

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: medium

RUSSIAN COMBAT AIRCRAFT

Type: Close air support

Su-25 Frogfoot

Recognition features:

- high-wing, swept leading edge, square trailing edge, wing-tip pods
- single tall tail fin with smaller aft upward canted tail plane on aft projecting boom
- short sloping nose and canopy, flattened fuselage sides and bottom, rounded engine nacelles with aft projecting circular outlets
- many under-wing weapon hard points and large nose mounted cannon
- fully retractable tricycle undercarriage

Armament:

- 30mm cannon
- AA-8A Aphid IR guided air-to-air missiles
- 80mm unguided rockets

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: medium

RUSSIAN COMBAT AIRCRAFT

Type: Multi-role fighter

Mig-29 Fulcrum

Recognition features:

- low-wing, swept leading and trailing edges, wings blended to fuselage
- all-moving swept tail plane and canted twin tail fins
- downward-pointing nose, 'humped-back' fuselage aft of cockpit tapering to flattened projecting 'fish-tail' section at rear, flattened fuselage underside
- separated under-fuselage engine nacelles with canted and angled rectangular air intakes and widely spaced rear nozzles
- under-wing hard points and side-mounted cannon
- retractable tricycle undercarriage

Armament:

- 30mm cannon
- AA-10A Alamo radar guided air-to-air missiles
- AA-10B Alamo IR guided air-to-air missiles
- AA-11 Archer IR guided air-to-air missiles
- AS-10 Karen IR guided air-to-surface missiles

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: medium

RUSSIAN COMBAT AIRCRAFT

Type: Carrier-borne attack

Yak-41 Freestyle

Recognition features:

- high-wing, swept leading edge, square trailing edge with slight sweep along outer section, wing-tip pods
- compact square-sided fuselage with angled side air intakes and short nose with 'up-front' cockpit
- distinctive twin tail booms and canted fins, cutaway for extendable thrust vectoring engine nozzle
- under-wing hard-points
- retractable tricycle undercarriage

Armament:

- 30mm cannon
- AA-8A Aphid IR guided air-to-air missiles
- 80mm unguided rockets

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: medium

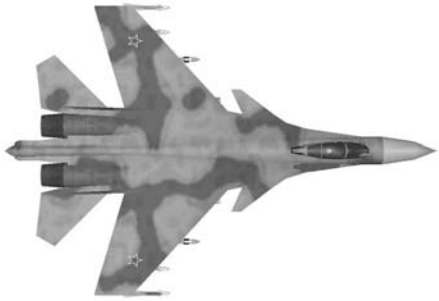
RUSSIAN COMBAT AIRCRAFT

Type: Carrier-borne interceptor

Su-33 Flanker

Recognition features:

- low-wing, swept leading and trailing edge, blended to fuselage, swept canard foreplanes
- downward angled forward fuselage with enlarged bulbous nose section, 'humped-back' central fuselage tapering to flattened projecting 'tail-sting' at rear
- swept tail plane and twin vertical tail fins
- separated under-fuselage engine nacelles with canted and angled rectangular air intakes and large widely spaced rear nozzles
- under-wing and fuselage hard-points with wing-tip missile mounts
- retractable tricycle undercarriage



Armament:

- 30mm cannon
- AA-8A Aphid IR guided air-to-air missiles
- AA-8B Aphid radar guided air-to-air missiles
- AA-10A Alamo radar guided air-to-air missiles
- AA-10B Alamo IR guided air-to-air missiles
- AS-14 Kedge laser guided air-to-surface missiles

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: medium

RUSSIAN TRANSPORT AIRCRAFT

Type: Medium-lift

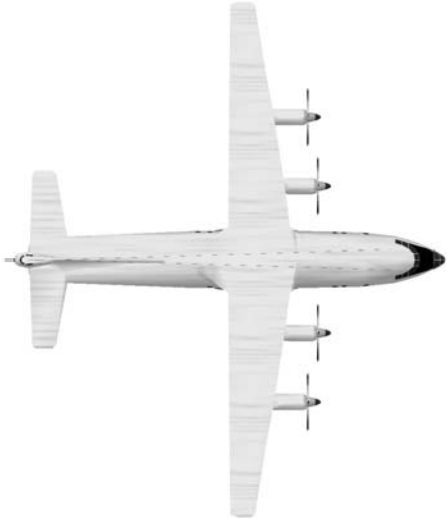
An-12B Cub

Recognition features:

- 4 turboprop engines with 4-bladed propellers on under-wing nacelles
- high-wing configuration with swept leading edge and downward canted wing tip sections
- large angled tail fin incorporating tail gun turret, tail plane set well aft
- large circular-sectioned fuselage tapering to broadly flattened tail boom at rear, rounded sponsons to lower fuselage center section
- smoothly rounded nose section tapering to glazed observation turret below wrap-around cockpit glazing, chin-mounted radome feature
- large inward hinging cargo doors to rear under sloping tail underside
- retractable undercarriage with 4 fixed main wheels arranged 2 pairs at rear and twin steerable nose wheels

Decoys:

- chaff
- flares



Game notes:

- radar symbol: ◆
- ground radar priority: medium

RUSSIAN TRANSPORT AIRCRAFT

Type: Heavy-lift

IL-76MD Candid

Recognition features:

- 4 large slender turbo-fan engines mounted on forward-projecting under-wing pylons with 'clam shell' thrust reversing exhaust outlets to rear
- swept high-wing configuration, large downward sloping tapered wings with large underwing flaps and projecting supporting fins
- large slender circular-section main fuselage bulging at wing junction, gently upward curving tail section tapering to rear tail gun turret, with large rear hinged loading ramp to cargo hold
- curved sponson arrangement on lower central fuselage with additional main undercarriage pod on underbelly
- swept T-tail configuration with large forward rectangular sectioned projection atop
- distinctive smoothly rounded tapering nose section incorporating glazed observation station, large radome section and wrap-around glazed cockpit
- retractable undercarriage with 16 fixed main wheels arranged on 4 axles at rear and 4 co-axial steerable nose wheels

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: medium

RUSSIAN ARMORED VEHICLES

Type: Main battle tank

T-80U

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on either side
- long and low flat-sided hull with front and rear splashers curving down over track ends, front top-side of hull slopes down between side-skirts, distinctive pair of fuel barrels mounted on rear
- distinctive low circular domed turret with hatch mounted MG and stowed snorkel on brackets at rear
- long high calibre main gun barrel overhangs hull front

Armament:

- 125mm gun
- 12.7mm machine gun
- AT-11 Sniper laser beam riding anti-tank missiles

Decoys:

- smoke grenades

Game notes:

- radar symbol: 
- ground radar priority: medium
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armored
- night vision equipment

Type:Infantry fighting vehicle

BMP-2

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on either side
- angular low-profile hull with sloping underside and sharply pointed leading edge, flattened rear with bulged access doors, curved-ended splashers to tracks projecting along sides
- small circular turret with sloping sides and flat top offset to aft, long slender low calibre main gun barrel and turret mounted tubular missile launcher

Armament:

- 30mm cannon
- AT-5 Spandrel radar guided anti-tank missiles

Decoys:

- smoke grenades

Game notes:

- radar symbol: 
- ground radar priority: high
- surface-to-air ceiling 2,000m
- surface-to-air range 4,000m
- armored
- night vision equipment

RUSSIAN ARMORED VEHICLES

Type: Infantry fighting vehicle

BMP-3

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on either side
- high-sided box shaped hull, sloping underside to front with pointed leading edge and flattened rear end, troop compartment main access doors on rear topside and rear end of hull
- small circular flat-topped turret, high caliber main gun barrel with box-shaped laser sight mounted over base and side-mounted co-axial cannon

Armament:

- 100mm gun • 30mm cannon
- AT-10 Stabber laser beam riding anti-tank missiles

Decoys:

- smoke grenades

Game notes:

- radar symbol: 
- ground radar priority: high
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armored
- night vision equipment

Type: Armored personnel carrier

BTR-80

Recognition features:

- high 8-wheeled chassis, 2 pairs of 4 wheels
- angular long narrow hull with sloping underside to front, flattened rear end and sloped upper sides with angular wheel arches below
- very small circular flat-topped MG mounted turret

Armament:

- 14.5mm machine gun

Decoys:

- smoke grenades

Game notes:

- radar symbol: 
- ground radar priority: medium
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armored
- night vision equipment

RUSSIAN ARMORED VEHICLES

Type: Scout car

BRDM-2

Recognition features:

- high 4-wheeled chassis
- angular small and narrow hull, sharp leading edge and sloping underside to front, sloping upper sides with curved wheel arches below, flattened rear end
- very small circular flat-topped MG mounted turret

Armament:

- 14.5mm machine gun

Game notes:

- radar symbol: ●
- ground radar priority: medium
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armored
- night vision equipment

RUSSIAN SELF-PROPELLED ARTILLERY

Type: Artillery (howitzer)

2S19 (152mm)

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on either side
- long and low flat-sided hull with front and rear splashers curving down over track ends, front top-side of hull slopes down between side-skirts
- very large high-sided box-shaped turret with hatch-mounted MG and distinctive rear-mounted SAM launcher tube
- very long high caliber main gun extending well forward of hull front

Armament:

- 152mm howitzer
- 12.7mm machine gun

Decoys:

- smoke grenades

Game notes:

- radar symbol: ■
- ground radar priority: medium
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armored
- night vision equipment

RUSSIAN SELF-PROPELLED ARTILLERY

Type: Multiple rocket systems

BM-21 Grad MRS (122mm)

Recognition features:

- high 6-wheeled truck chassis - 2 wheels at front, 4 at rear
- low wide radiator grille, smooth curved tapering bonnet and short upright cab with backward sloping windshield, vertical faced mud guards over front wheels with integral headlights, flatbed platform behind with launcher turret over rear axle
- box-shaped grouped rocket tubes stowed on turret at rear, turned and pitched to firing position

Armament:

- 122mm rockets

Game notes:

- radar symbol: ●
- ground radar priority: low

RUSSIAN AIR DEFENSE VEHICLES

Type: SAM

SA-13 Gopher

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on either side, no side-skirts
- long low-profile flat-topped hull with tapering cab sides and sloping top/underside to front, box-shaped side-mounted stowage lockers along upper sides, flattened rear end
- centred circular turret mount for launcher arm with side-mounted box-section rocket launchers, stowed laid flat on hull top and pivoted on arm to firing position

Armament:

- SA-13 Gopher IR guided surface-to-air missiles

Game notes:

- radar symbol: ▲
- ground radar priority: high
- surface-to-air ceiling 3,000m
- surface-to-air range 5,000m
- armored
- night vision equipment
- Flat Box passive radar

RUSSIAN AIR DEFENSE VEHICLES

Type: SAM/AAA

SA-19 Grison

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on each side, no side-skirts
- box-section hull, downward sloping front, flattened and slightly inward sloping rear end
- long and narrow rectangular main turret section over-hanging circular turret base at rear, frontal radome mounting, curved rectangular radar dish mounted on elevated section at turret rear top
- twin-barreled cannon and quad SAM tubes mounted on either turret side

Armament:

- 4x30mm cannons
- SA-19 Grison radio command guided surface-to-air missiles

Game notes:

- radar symbol: ▲
- ground radar priority: high
- surface-to-air ceiling 4,000m
- surface-to-air range 8,000m
- armored
- night vision equipment
- surveillance and tracking radar

RUSSIAN TRANSPORT VEHICLES

Type: Light 4x4 vehicle

UAZ-469B

Recognition features:

- high 4-wheeled chassis,
- small compact appearance, distinctive rounded bonnet, headlights and radiator grille, backward sloping windshield, canvas roof

Game notes:

- radar symbol: ●
- ground radar priority: low

RUSSIAN TRANSPORT VEHICLES

Type: Utility vehicle (truck)

Ural-4320

Recognition features:

- high 6-wheeled truck chassis - 2 wheels in front, 4 at rear
- low wide radiator grille, smooth curved tapering bonnet and short upright cab with backward sloping windshield, vertical faced mud guards over front wheels with integral headlights
- high sided canvass covered cargo area to rear

Game notes:

- radar symbol: ●
- ground radar priority: low

Type: Fuel tanker

Ural-4320 Fuel Tanker

Recognition features:

- high 6-wheeled truck chassis - 2 wheels in front, 4 at rear
- low wide radiator grille, smooth curved tapering bonnet and short upright cab with backward sloping windshield, vertical faced mud guards over front wheels with integral headlights
- squat flat-sided curved-topped fuel tank at rear

Game notes:

- radar symbol: ●
- ground radar priority: low

RUSSIAN WARSHIPS

Type: Amphibious assault ship

Kiev Class

Recognition features:

- slender hull with sharp raked bow profile and broad square front deck, angled square stern with stepped sunken aft deck sections
- large cylindrical missile launch tubes on forward deck
- angled flight deck overhangs port hull side
- large angular multi-leveled starboard side superstructure, tall lattice mast with spherical radome aft of main radar dish, large angular funnel to rear, side-mounted radomes
- numerous smaller radar sensors, missile launchers and gun turrets
- stowed pilot boats in aft hull recesses

Armament:

- SA-N-4 Gecko radio command guided surface-to-air missiles

- 30mm cannons • 76mm gun
- SA-N-3 Goblet radio command guided surface-to-air missiles

Game notes:

- radar symbol:
- ground radar priority: high
- surface-to-air ceiling 5,000m
- surface-to-air range 10,000m

Type: Frigate

Krivak II Class

Recognition features:

- slender low-profile hull, raked bow with curved front deck, low flat sunken aft deck with broad curve to stern
- large box-shaped missile launcher on forward deck with angular canted blast shields to fore
- broad rectangular forward superstructure with large squat lattice mast and radar dishes atop
- low aft superstructure with squat rectangular funnel
- aft twin stepped gun turret arrangement

Armament:

- 100mm guns
- SA-N-4 Gecko radio command guided surface-to-air missiles

Game notes:

- radar symbol:
- ground radar priority: high
- surface-to-air ceiling 5,000m
- surface-to-air range 10,000m
- air search radar

RUSSIAN WARSHIPS

Type: Hovercraft

AIST

Recognition features:

- long and wide high-sided hull with curved upper edge and rounded overhanging bow section over loading ramp below, high-sided all-round inflatable skirt with enlarged curved bulge under bow door
- twin forward-mounted gun turrets either side of bow
- low and wide forward bridge section with squat lattice mast to rear, large low square structure amidships
- aft mast-mounted twin pairs of face-to-face 4-blade propeller sets forward of tall twin tail fins/rudders

Armament:

- 30mm cannons

Game notes:

- radar symbol: 
- ground radar priority: high
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m